

NOATAK RIVER SONAR ESCAPEMENT ESTIMATE

1994

by

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ABSTRACT

The Noatak River sonar project was designed to provide timely inseason estimates of chum salmon *Oncorhynchus keta* passage past commercial and subsistence fisheries in the vicinity of Kotzebue. In 1994, the sixth year of operation at river km 39, we estimated fish passage using single-beam hydroacoustic gear from 22 July through 10 September. This was the second year we used a 120 kHz sonar system and the first year we estimated total river fish passage with the successful implementation of radiotelemetered data collection on the left bank. We fished drift gillnets and used the data to apportion sonar counts to species. An estimated total of 214,000 fish passed the site, with 93 and 7 percent passing on the right and left bank, respectively. The total included 161,663 chum salmon (SE= 14,026), 14,062 char *Salvelinus alpinus* (SE= 2,218), 33,982 humpbacked whitefish *Coregonus pidschian* (SE= 3,607) and 4,293 other species (SE= 1,591).

River levels in 1994 were the highest since project initiation. Flooding of the lower Noatak River drainage from 18-22 August required complete removal of the underwater sonar systems during this time period. Daily patterns of fish passage were not observed in 1994 during periods of low ambient light late in the season when water clarity was low (secchi < 1 m). This was inconsistent with previous years, when a diel pattern of fish movement occurred during periods of high water clarity (secchi > 1 m) late in the migration.

Sonar and test net data were collected throughout most of the entire season on the left bank of the river. Radiotelemetry was successfully used to remotely start and stop equipment, aim the transducer, and collect data on the left bank while operating the equipment from the right bank. The successful implementation of the radiotelemetry system allowed us to more completely ensonify the river and provided a better estimate of fish passage.

Dual-beam data was collected at the beginning and end of the season from the right bank. Two types of data were collected; stationary artificial target and migrating fish.

KEY WORDS: chum salmon, char, Noatak River sonar, hydroacoustic, species apportionment, escapement, radiotelemetry, dual-beam

INTRODUCTION

Noatak River chum salmon *Oncorhynchus keta* stocks support commercial and subsistence harvests in Kotzebue Sound and subsistence harvest in the lower Noatak River. Effective management of this resource requires timely knowledge of escapement through the primary fisheries located in Kotzebue Sound. Inseason escapement information is one of several factors which, taken together, provide a basis for fishery management decisions. Estimates of annual escapement may also enable prediction of future year run strength and determination of optimum escapement goals.

The Noatak River flows approximately 680 km from its headwaters in the Schwatka Mountains to Kotzebue Sound. Multiple channels, slow current and unstable banks characterize the lower 30 km. Silty water and the wide, multi-channel river mouth preclude the use of visual fish counting techniques, such as towers and weirs, for estimates of fish passage. These conditions have historically necessitated the use of aerial survey observations from clear water spawning areas as an index of wild stock escapement. The many limitations of aerial surveys, such as lack of timeliness and dependence of accuracy on variable weather and river conditions, prompted investigation into use of hydroacoustic (sonar) techniques to estimate salmon escapement on the Noatak River. Feasibility studies that were designed to ascertain the applicability of sonar to this problem began in 1979 on the lower Noatak River (Bird and Bigler 1982; Bigler 1983; Bigler 1984; Berning et al. 1987). The current lower canyon site, located at km 39 (Figure 1) was chosen in 1988 for favorable features including a single, relatively narrow (240 m) channel, stable banks, proximity to the river mouth, and smooth, v-shaped bottom profile of moderate (20 m maximum) depth. On the right bank there is a gradual slope of approximately 6° from shore out 180 m to the thalweg. The substrate is sandy and silty and water velocity is low during medium to low water levels. On the left bank there is a steeper slope of approximately 17° from shore out 60 m to the thalweg. The substrate is bedrock and water velocity is higher. A camp was constructed and a 420 kHz sonar system deployed on the right bank at this location during July and August 1989 (Fleischman and Huttunen 1990).

Estimates of fish passage by species were generated for the right bank of the river for years 1990, 1991, 1992, and 1993. These data were consistent with other indicators of abundance, and were viewed by area fishery managers as valuable information for consideration in management decisions (Lean and Lingnau 1994). In 1992, we tested deployment and operation of lower (120 kHz) frequency sonar gear on both banks of the river (LaFlamme et al. 1993). In 1993, we committed to operating with the lower 120 kHz frequency on both banks of the river (LaFlamme et al. 1995). This allowed us to maximize cross-sectional area estimates while increasing the maximum sampling range.

The primary objective for the 1994 field season was to estimate both right and left bank chum salmon passage at river km 39 of the Noatak River between 20 July and 10 September and to provide associated variance estimates to fishery managers as needed.

METHODS

Sonar Operations

Equipment

Sonar equipment deployed on the right bank included a Biosonics model 101 echo sounder, International Transducer Company (ITC) model 5398 4° x 10°, 7° x 21° elliptical dual-beam transducer, Biosonics model 111 thermal chart recorder, and a Hewlett Packard (HP) model 54501A digital-storage oscilloscope.¹ Sonar equipment deployed on the left bank included a Biosonics model 105 echo sounder, Biosonics 10° x 25° circular dual-beam transducer, Biosonics model 111 chart recorder, and a radiotelemetry system. Each sounder-transducer-cable combination was calibrated by Precision Acoustic Systems (PAS) and field tested by Alaska Department of Fish and Game (ADF&G) staff prior to the field season. Transducers were mounted on aluminum tripods placed within 5 m of shore and aimed with a remote-controlled pan and tilt unit manufactured by Remote Ocean Systems (ROS).

Left bank data collection was collected via radiotelemetry equipment. The telemetry gear allowed for remote control of the sonar equipment from the right bank as well as recording of left bank data on a right bank chart recorder. A radiotelemetry system, developed cooperatively by staff from the Sonar and Technical Services (STS) group of ADF&G and the University of Alaska Fairbanks-Geophysical Institute (GI-UAF), was successfully tested on the Noatak River in 1992 (LaFlamme et al. 1993), unsuccessfully installed in 1993 (LaFlamme et al. 1995), and installed in 1994. Telemetry equipment on each bank included a custom-manufactured control box, two unidirectional Yagi antennae, one whip antenna, and one antenna tower with base anchor. A Biosonics model 281 Echo Signal Processor (v 2.1) installed in a Compaq 386/20e personal computer was used to collect dual-beam data. All equipment was powered by 3500 watt Honda gas generators.

Deployment and Aiming

On the right bank the transducer was mounted with the narrow (4° x 10°) elliptical beam oriented in the y axis, with the 4° axis in the vertical. It was aimed so that the lower -6 dBV

¹ Companies referenced in this report were listed for archival purposes only. Such references do not represent endorsement by the State of Alaska, Department of Fish and Game.

edge of the beam grazed the bottom contour of the river. On the left bank the transducer was mounted so that the upper -6 dBV edge of the narrow (10°) circular beam grazed the surface of the river. Each transducer was deployed directly across from the other transducer (Figure 2). Effects of crosstalk between the two systems was reduced by aiming the transducers away from each other and by using different pulse width settings. The right bank transducer was aimed 20° upstream from perpendicular to the shore and the left bank transducer was aimed 20° downstream from perpendicular to shore. Right bank data was collected with a pulse width set at 0.4 ms and left bank data was collected with a pulse width set at 0.8 ms.

Sampling Schedule

Once each sonar system was setup each bank was operational 24 hours per day 7 days per week, except for brief periods at 0800 and 2000 when the generators were refueled and serviced. Sonar operation was not monitored continuously but instead was checked by technicians periodically throughout the day.

Fish traces in 20 m range intervals for the right bank and 10 m range intervals for the left bank were tallied for 15 minute time intervals from chart recordings. Technicians tallied fish traces and recorded data from both banks three times per day. The project leader and crew leader supervised interpretation and recording of the data each day to ensure interpretive consistency. Water level, read from a staff gauge in the river, secchi disk readings and water temperature were taken twice daily while test netting. Notes regarding sonar operations and water conditions were written to electronic file.

Sounder and Threshold Settings

Sound pulses were generated by the echosounders at 120 kHz with a pulse width of 0.4 ms on the right bank and 0.8 ms on the left bank; bandwidth was 5 kHz on the right bank and 2.5 kHz on the left bank. Pulse repetition frequency was 3.3 Hz on the right bank and 5 Hz on the left bank; maximum range was 180 m from the right bank transducer and 60 m from the left bank transducer. For right bank data acquisition, the narrow beam signal was routed to the oscilloscope and to a chart recorder which ran continuously at a paper speed setting of 1/8 mm per pulse. For left bank data acquisition, the narrow beam signal was received on the right bank and recorded by a radio-linked chart recorder which ran continuously at a paper speed setting of 1/8 mm per pulse.

The right bank chart recorder threshold was set to detect a -39 dB target 6 dBV off the maximum response axis, as calculated from the preseason calibration data. The left bank chart recorder threshold was set to detect a -39 dB target 3 dBV off the maximum response axis. This higher setting was necessary for a legible display of targets due to the presence of a lower signal-to-noise ratio caused by the hard bedrock substrate on the left bank.

Dual-beam Data Acquisition

In situ Calibration. A tungsten carbide sphere (diameter 38 mm) was used for *in situ* calibrations. This was done to verify the consistent stability of the acoustic systems. The artificial target was tied with monofilament line attached to a horizontal pole at the top and anchored with a rock at the bottom, and deployed from an anchored boat (Figure 3). Data was collected at one offshore range (17.5 m) on the right bank. Data collection was unsuccessfully attempted on the left bank.

Fish Passage. Dual-beam data was collected from migrating fish during two time periods. The first was completed on 29 July and the second began on 3 September. These time periods were to coincide with lower relative abundances of chum salmon and higher relative abundances of whitefish, and higher relative abundances of chum salmon, respectively. Software collection thresholds were set 3 dBV higher than chart recorder thresholds to filter the amount of unusable data collected from background noise sources.

Test-fishing Operations

Equipment

Gillnets were drifted in three separate areas: 1) from the right bank transducer nearshore to approximately 70 m offshore, 2) midriver, and 3) from the left bank transducer nearshore to approximately 60 m offshore to provide information used for species apportionment. The following nets, all 45.7 m (25 fathoms) long and hung at a 2:1 ratio, were used:

- 1) 70 mm (2.75") mesh mono-twist (#1.5 x 10 strand) gillnet, 126 meshes (6.6 m) deep.
- 2) 102 mm (4") mesh mono-twist (#1.5 x 10 strand) gillnet, 70 meshes (5.3 m) deep.
- 3) 127 mm (5") mesh mono-twist (#1.5 x 10 strand) gillnet, 56 meshes (5.3 m) deep.
- 4) 152 mm (6") mesh mono-twist (#1.5 x 10 strand) gillnet, 47 meshes (5.4 m) deep.

Deployment and Sampling Schedule

All mesh sizes of drift gillnets were fished 7 days per week at 1000 and 1600 hours. The 2.75 in and 6 in mesh were drifted twice per day, while the 4 in and 5 in mesh were drifted once per day. The 4 in and 5 in mesh were alternated between fishing periods every other day. Nearshore nets were fished with one end attached to a boat and the other end attached to a rope which was walked along shore. The distance from shore to the inshore end of the net was approximately 20 m on the right bank and 10 m on the left bank, depending on water level. The inshore end of the nets was closer to shore during periods of higher water levels. One midriver drift was done with each mesh fished during each fishing period. Each drift originated no more than 5 m below each tripod and lasted not longer than 10 minutes on the nearshore right bank, and 5 minutes on the nearshore left

bank and midriver.

Drift duration was shortened when necessary to limit catches during periods of high fish passage. We tried not to catch more than 20 fish in one drift. Captured fish were disentangled after the net was fully retrieved into the boat, identified to species, and measured, mid-eye to tailfork for salmon; snout to tailfork for all others, to within 5 mm. A scale was taken from every chum salmon and provided to area managers for age analysis. Fish were provided to area residents for subsistence use.

Analytical Methods

Sonar Estimates of Fish Passage

Sonar counts from the right and left bank were tallied by 15 minute intervals except for brief and infrequent periods when the sonar was not operational. Estimated fish passage N on bank b on day d was estimated as

$$\hat{N}_{bd} = 96 \cdot \bar{n}_{bd} , \quad (1)$$

where \bar{n}_{bd} = average number of targets detected during all 15 minute intervals on bank b on day d .

Total passage estimates for each day d was

$$\hat{N}_d = \sum_b \hat{N}_{db} . \quad (2)$$

Species Apportionment

Gillnet Selectivity. Drift gillnet catch per unit effort (CPUE) values, adjusted for net selectivity, were used to estimate species proportions. Because of the size selectivity of gillnets, catches from several nets were used to estimate the relative abundance of each species. Gillnet catches were adjusted for differing relative probability of capture (selectivity) among mesh sizes and fish length classes. We used an indirect method (Fleischman, personal communication) similar to those of McCombie and Fry (1960) and Ishida (1969) to estimate the selectivity of our mesh sizes to different length classes of chum

salmon, pink salmon, and char. The method compares, within fish length classes, the relative catches by different mesh sizes and tests for a linear relationship between optimal mesh size and fish length class for each species. If found, it then exploits this relationship to scale the relative catches between length classes. The method assumes equal maximum selectivity for each mesh size but otherwise does not make assumptions about the shape of the individual curves. For a comprehensive discussion of net selectivity see Hamley (1975).

Chum salmon relative abundance was estimated from catches in 5 in and 6 in mesh nets (Appendix A). Arctic char *Salvelinus alpinus* relative abundance was estimated from catches in 2.75 in, 4 in, 5 in, and 6 in mesh nets. Humpback whitefish *Coregonus pidschian* relative abundance was estimated from catches in the 2.75 in mesh net, and pink salmon *Oncorhynchus gorbuscha* relative abundance was estimated from catches in 4 in and 5 in mesh nets. Net selectivity estimates used for 1994, derived from 1991 and 1992 test-fishing data, are found in Appendix B. Gillnet data from 1991-92 showed that over 90% of all whitefish were captured with 2.75 in gear. The sample size for whitefish length classes in all other nets was too small to develop selectivity curves for paired meshes for whitefish. The mean probability of capture of all mesh sizes for all species was used to adjust for selectivity for whitefish in the 2.75 in mesh.

Species Proportions. To apportion sonar passage estimates to species by bank, catch c of species i and length class l during drift j of mesh m during fishing period f on bank b on day d was first adjusted for selectivity s of species i and length class l in mesh m . Adjusted catch a was calculated as

$$a_{dbfilmj} = \frac{c_{dbfilmj}}{s_{ilm}} \quad (3)$$

Total effort, in fathom hours, of drift j with mesh size m during fishing period f on bank b on day d was calculated as

$$e_{dbfmj} = \frac{25 \cdot t_{dbfmj}}{60} \quad (4)$$

where t denotes drift time in minutes and 25 equals the length of nets in fathoms. CPUE, across all drifts j with all mesh sizes m , for length class l of species i during testfishing period f on bank b on day d was total adjusted catch divided by total effort

$$CPUE_{dbfil} = \frac{\sum_m \sum_j a_{dbfilmj}}{\sum_m \sum_j e_{dbfmj}} . \quad (5)$$

CPUE was then summed across all length categories for each species i , and the proportion p of species i during fishing period f on bank b on day d was estimated as the ratio of CPUE for species i to the total CPUE for all species

$$\hat{p}_{idbf} = \frac{\sum_l CPUE_{dbfil}}{\sum_i \sum_l CPUE_{dbfil}} .$$

For bank b on day d , the estimated proportion of species i was estimated as

$$\hat{p}_{idb} = \frac{\sum_l CPUE_{dbfil}}{\sum_i \sum_l CPUE_{dbfil}} . \quad (7)$$

Fish Passage by Species. To estimate passage by species, estimates of both sonar passage and species proportions are pooled into two reporting periods per week, scheduled to provide the most timely information for fishery managers. The sonar estimate of total fish passage for bank b of report period t containing all days d was calculated as

$$\hat{N}_{bt} = \sum_{d \in t} \hat{N}_{bd} , \quad (8)$$

and pooled species proportions for bank b for each reporting period t were estimated as

$$\hat{p}_{ibt} = \frac{\sum_{d \in t} \sum_f \sum_l CPUE_{dbfil}}{\sum_i \sum_{d \in t} \sum_f \sum_l CPUE_{dbfil}} . \quad (9)$$

The passage N of species i on bank b during report period t was estimated as

$$\hat{N}_{ibt} = \hat{p}_{ibt} \cdot \sum_{d \in t} \hat{N}_{db} . \quad (10)$$

Variances and Confidence Intervals

There are at least two components that contribute to the variance of species passage estimates: (1) the sonar estimate of total fish passage, and (2) the drift gillnet estimates of species proportions.

Total Fish Passage. For the purposes of variance calculations, the sonar component of variance was assumed to be zero due to the high sonar sampling intensity.

Species Proportions. To estimate the variance of species proportion i during reporting period t , we treated the drift gillnet catch on bank b during day d and fishing period f as a replicate cluster sample and weighted each squared deviation by the relative adjusted CPUE (total for all species) for that fishing period (Cochran 1977:64, Fleischman et al. 1990):

$$\hat{Var}(\hat{p}_{ibt}) = \frac{1}{n_{bt}} \sum_d \sum_f \left(\frac{m_{dbf}}{\bar{m}_{bt}} \right)^2 \frac{(\hat{p}_{idbf} - \hat{p}_{ibt})^2}{n_t - 1} , \quad (11)$$

where: n_{bt} = number of fishing periods on bank b in reporting period t ,
 m_{dbf} = drift gillnet CPUE (all species) on bank b on day d , fishing period f ,
and

\bar{m}_{bt} = mean drift gillnet CPUE (all species) during all fishing periods on bank b in reporting period t .

Fish Passage by Species. Estimated variance of species passage estimates N_{ibt} was:

$$\hat{Var}(\hat{N}_{ibt}) = \hat{N}_{bt}^2 \cdot \hat{Var}(\hat{p}_{ibt}) . \quad (12)$$

Finally, variance estimates for species i on bank b were summed over all report periods to estimate the variance of the season total passage \hat{N}_{ib} i.e.,

$$\hat{Var}(\hat{N}_{ib}) = \sum_t \hat{Var}(\hat{N}_{ibt}) . \quad (13)$$

Sonar and drift gillnet data were entered into Quattro Pro worksheets and an Rbase for DOS database, respectively. Data processing was done with SAS (Release 6.04) programs (Appendix C).

RESULTS

River Conditions

River conditions varied throughout the season. Water level remained relatively constant during the early season (Figure 4). High levels of precipitation throughout the majority of the season resulted in flooding conditions between 16 and 24 August in the lower part of the Noatak River drainage. Water temperature decreased over the entire season. Water clarity was variable during the early season, with secchi readings ranging from 0.25 to 1.20 m. After 9 August mean secchi was 0.24 m.

Right Bank Fish Passage

Sonar equipment was fully operational on the right bank on 22 July and data collection continued through 10 September. With some exceptions, the equipment ran continuously, 24 hours per day, 7 days per week, excluding two daily 15 minute periods, 12 hours apart, required for generator refueling and maintenance. Data acquisition was occasionally interrupted when changing river conditions necessitated moving the tripod or re-aiming the transducer. During the time period from 18-22 August, bank full river levels forced complete removal of the underwater sonar system. Missing data for these days were interpolated from data collected on 17 and 23 August.

We counted 168,884 traces from 0-180 m on the chart recordings. From those data we estimated a total passage of 198,604 fish by the right bank sonar through 10 September. The difference resulted in an average daily expansion factor of 1.023 and an overall seasonal expansion factor of 1.176. Estimates of abundance by species include 150,300 chum salmon (SE = 4,396), 11,779 char (SE = 2,186), 32,448 whitefish (SE = 3,551) and 3,692 other species (SE = 1,512).

We drifted gillnets 458 times on the right bank from 22 July through 10 September. Fishing effort totaled 358, 247, 82, and 285 fathom-hours for the 2.75 in, 4 in, 5 in, and 6 in meshes, respectively. The catch included 1,036 chum salmon, 102 char, 227 whitefish, and 9 pink salmon (Appendix D). Other species caught included Northern pike *Esox lucius*, sheefish *Stenodus leucichthys*, burbot *Lota lota*, starry flounder *Platichthys stellatus*, longnose sucker *Catostomus catostomus*, and cisco *Coregonus spp.* A comparison of daily chum salmon CPUE and daily total estimated fish passage is presented in Figure 5.

Left Bank Fish Passage

Sonar equipment was fully operational on the left bank on 30 July and data collection continued through 10 September. Remote aiming problems on the left bank delayed the start of data collection relative to right bank data collection startup. Passage estimates from 22-29 July were extrapolated using the average ratio of left bank counts to right bank counts between 30 July and 5 August. With some exceptions, the equipment ran continuously, 24 hours per day, 7 days per week, excluding two daily 15 minute periods, 12 hours apart, required for generator refueling and maintenance. Data acquisition was occasionally interrupted when changing river conditions necessitated moving the tripod or re-aiming the transducer. During the time period from 18-24 August, bank full river levels forced the complete removal of the sonar system. Missing days data were interpolated from data collected on 17 and 25 August for passage estimates on 18-22 August. Missing data for 23 and 24 August were extrapolated using the average ratio of left bank counts to right bank counts between 14-17 August and 25 and 26 August.

We counted 9,749 traces from 0-60 m on the chart recordings, and from those data estimated passage of 15,397 fish by the left bank sonar through 10 September. The difference resulted in an average daily expansion factor of 1.031 and an overall expansion factor of 1.579. Estimates of fish by species include 10,922 chum salmon (SE = 589), 2,026 char (SE = 374), 1,850 whitefish (SE = 635) and 601 other species (SE = 496).

We drifted gillnets 377 times on the left bank from 22 July through 10 September. Fishing effort totaled 201, 123, 54, and 163 fathom-hours for the 2.75 in, 4 in, 5 in, and 6 in meshes, respectively. The catch included 392 chum salmon, 38 char, 29 whitefish, and 3 pink salmon (Appendix E). Other species included coho salmon *Oncorhynchus kisutch*, pike, burbot, and cisco. A comparison of daily chum salmon CPUE and daily total estimated fish passage is presented in Figure 5.

Total River Fish Passage

Total river fish passage was estimated at 214,000, with 93 and 7 percent passing on the right and left bank, respectively. Passage estimates by species included 161,663 (SE = 14,026) chum salmon, 14,062 (SE = 2,218) char, 33,982 (SE = 3,607) whitefish, and 4,293 (SE = 1,591) other species (Table 1). Peak daily passage was 8 August for chum salmon, 2 September for char, and 29 July for whitefish (Figure 6). Date of 50% passage was 9 August for chum salmon, 30 August for char, and 11 August for whitefish (Table 2). A comparison of daily estimated passage between banks is presented in Figure 7.

We examined the hourly fish count data for evidence of daily-patterns of movement during two, 7 day periods of data collection. During the time period from 11-17 August, and from 25-31 August, water clarity was low (secchi < 1 m) and there was no indication of diel patterns in passage (Figure 8). Overall seasonal range distributions of targets that passed the site peaked at 80 m from the right bank (Figure 9).

Drift gillnet data used for species apportionment of total passage resulted in estimated passage of 75% chum salmon, 7% char, 16% whitefish, and 2% other species. Daily passage estimates were as high as 96% for chum salmon, 40% for char, and 70% for whitefish (Figure 10).

Length distributions of captured chum salmon and whitefish were well separated in 1994 (Figure 11). Chum salmon mean length was 572 mm (SD = 35.81, n = 1,462) and whitefish mean length was 342 mm (SD = 35.61, n = 257). These data are presented in Table 3. The separation of the means is 230 mm. Char length classes were skewed and overlapped with whitefish and to a lesser degree with chum salmon distributions. Mean length was 410 mm (SD = 92.72, n = 140).

Dual-beam Data Collection

Dual-beam data was collected on the right bank from 26-29 July, and from 3-5 September. Analysis of data collected from the tungsten carbide sphere on 26 July resulted in a target strength estimation of -43.95 dB (SD=2.53; n= 598; range=17.5 m). Data collected from migrating fish for the time period 27-29 July resulted in individual target strength estimates between -18.37 dB and -33.51 dB (Figure 12), with an average target strength of -25.44 dB (SD=2.16; n=1,162; range=22-120 m). Data collected from migrating fish on 4 September resulted in target strength estimates between -30.72 dB and -44.96 dB, with an average target strength of -37.86 dB (SD=3.82; n=194; range=12-30 m, 80-100 m). Estimated chum salmon proportions based on drift gillnets were 73% for 27-29 July and 65% for 4 September. No dual-beam data was collected from the left bank.

DISCUSSION

River Conditions

We recorded daily measures of water level, clarity, and temperature over five summers beginning in 1990. These data show an inverse relationship between water level and water clarity. There is no consistent seasonal pattern of variation in our observations of river conditions. They are affected primarily by ambient temperature and precipitation, which vary dramatically between and within years.

Right Bank Fish Passage

Drift gillnet data has been used for apportionment of sonar counts to species over the entire range ensoufied. Chum salmon estimates for the five years were 62% in 1990, 75% in 1991, 48% in 1992, 64% in 1993, and 76% in 1994 of the total right bank fish passage (Table 4). Char percentages were 24% in 1990, 9% in 1991, 30% in 1992, 16% in 1993, and 6% in 1994 for the five years, and whitefish percentages were 9% in 1990, 12% in 1991, 18% in 1992, 19% in 1993, and 16% in 1994.

The precision of estimates was again poor for individual reporting periods, but much better for the season estimates. Standard error as a percent of the estimate within a reporting

period ranged from one to 56 percent, which is comparable to relative precision observed in prior years. For the entire 1994 season, standard error as a percentage of the estimate was 3 percent for chum salmon, 19 percent for char, and 11 percent for whitefish.

The most critical area of the species composition program in which we had made an untested assumption (from 1990 through 1993), is that fish species composition is the same inside and outside the sampling range of the gillnets. Maximum offshore sampling range of the gillnets was increased from 70 m to approximately 120 m in 1994. The nets sample the area from surface down to 6.7 m (2.75 in mesh) or down to 5.5 m (4 in, 5 in, and 6 in mesh). The slope of the right bank is about 6°, therefore the entire water column is sampled to approximately 47 m from the transducer. Beyond 47 m, to the 120 m maximum range fished, the gillnets did not extend to the river bottom. The majority of all fish caught on the right bank were within 70 m of shore. The catch of chum salmon, char, and whitefish from 0-70 m was 89, 98, and 98 percent, respectively, of the total catch from 0-120 m. Raw counts at range 0-120 m accounted for 83 and 81 percent of the total raw counts from 0-180 m on the right bank in 1993 and 1994.

Nearshore passage of chum salmon on the right bank has been monitored with set gillnets in the past (1991 and 1992). Nets were deployed during the entire season in 1991 and during the early part of the 1992 season. No gillnets were set in the late part of 1992 or the entire 1993 season due to high water levels. Due to inconsistencies and unpredictability of water levels, set gillnetting procedures were eliminated in 1994. Record high water levels forced us to sample nearshore (0-20 m) populations with each gillnet for the majority of the season. Nearshore counts will probably be included in the total estimate in future years. Counts over this range have been included in final estimates only once (1991) prior to this season. Four years of data show that 16% in 1991, 9% in 1992, 17% in 1993, and 7% in 1994 of total right bank passage estimates occurred between 0-20 m.

Left Bank Fish Passage

The radiotelemetry system was successfully implemented on the left bank. Recent redesign of the radios by GI-UAF staff reduced problems encountered in 1992 and 1993. Acoustic data was collected from 0-60 m for the majority of the season.

Gillnets were drifted for the entire season on the left bank. We used the same technique of controlling the inshore end of the net from shore that was implemented on the right bank. Resultant catches showed that fish were captured along the entire length and depth of the net. We were able to sample out to the maximum offshore range of the ensounded area of the river, however, the depth of each net was not sufficient to sample the entire water column out to this range.

Estimates of species composition from drift gillnets on the left bank were comparable with

right bank estimates. Chum salmon accounted for 71%, char accounted for 13%, and whitefish accounted for 12% of the total left bank estimate.

The precision of estimates was poor for individual reporting periods, but much better for the season estimates. Standard error as a percent of the estimate within a reporting period ranged from 1 to 58 percent. These are comparable to right bank relative precision for 1994. For the entire 1994 season, standard error as a percentage of the estimate for the left bank was 5 percent for chum salmon, 19 percent for char, and 34 percent for whitefish.

Total River Fish Passage

Fish did not exhibit pronounced daily patterns of movement as the season progressed into increased hours of darkness in 1994. Between 25 and 31 August water clarity was low (secchi < 1 m). This behavior was consistent with that of 1992 but inconsistent with that of 1990, 1991, and 1993, during which fish passage slowed between 0100 and 0500 hours (the period of lowest ambient light intensity) when water clarity was high (secchi > 1.5 m) over the same part of the season.

Total river estimates of species composition from drift gillnets were 75% chum salmon, 7% char, and 16% whitefish. For the entire 1994 season, standard error as a percentage of the estimate was 8 percent for chum salmon, 16 percent for char, and 11 percent for whitefish.

Total river passage estimates were provided to fisheries managers for the first time in 1994. Estimates in previous years were from the right bank only, covering ranges of 0-100 m in 1990, 0-120 m in 1991 and 1992, and 0-180 m in 1993. Successful deployment of equipment on both banks in 1994 allowed us to sample the entire width of the river. We are currently unable to sample the entire water column due to transducer beam widths available for use at this site. Documented variability in river conditions within and between years has demonstrated the need for flexibility in transducer configuration to gain the flexibility required to sample the entire water column, particularly on the left bank. The left bank bottom contour is approximately 17° from shore out to the thalweg (0-60 m). We currently have a 10° transducer available for use at this site. The beam is wide enough to cover between 50 and 75 percent of the vertical plane, but too wide to allow for discrete stratification into upper and lower water column strata.

Dual-beam Data Collection

With the change of operating frequency from 420 kHz to 120 kHz in 1993, we collected data with which we may be able to determine the feasibility of setting acquisition thresholds using target strength estimates from stationary artificial targets. At this time it does not appear

that we will be able to estimate chum salmon escapement solely by using dual-beam data as we had once hoped. It is extremely difficult to differentiate fish in dense schools using dual-beam data processing techniques. Fish have travelled in groups past the sonar site 65 to 87 percent of the time from 1990 through 1993. In 1994, fish travelled in groups past the site only 10 percent of the time. This may have been due to inhibited schooling behavior as a consequence of very low water clarity over the majority of the season, due to extremely high water levels. This was the first time we had documented high levels of precipitation over the entire season at this site. Therefore, we anticipate that fish will likely continue to travel in groups during the more typical periods of low water levels and high water clarity.

The current drift gillnet program will likely need to be maintained in order to apportion sonar estimates between species. Display thresholds may be able to be confirmed by *in situ* dual-beam processing of stationary artificial target data, but laboratory system calibrations should be done prior to the start of the field season and threshold displays determined prior to deployment of each system.

CONCLUSIONS AND RECOMMENDATIONS

This was the sixth season of operation for the Noatak River sonar project. Right bank sonar deployment and operation using a single-beam system has been successful for the past four years and estimates of species passage and variance have been generated and provided for fishery management. Both right bank and left bank sonar deployment and operation was successful in 1994, the first year of providing total river estimates of fish passage for fishery management.

We currently have an effective means of estimating total river fish passage using a single-beam sonar system. Efficient data processing allows reporting of timely inseason escapement and associated sampling error estimates to fishery managers. The drift gillnet program is functioning at a level that is most effective for providing species apportionment estimates with the resources currently available.

Results from the 1994 field season have shown that:

- 1) The current level of temporal (24 hr) sonar sampling has provided a satisfactory precision of escapement estimates and we feel that we should continue this level of sampling in the future.
- 2) The increase in spatial sonar sampling to include the left bank has resulted in an effective

means of estimating total river passage rates.

- 3) The suite of nets used effectively samples targeted populations of chum salmon, char and whitefish.
- 4) The radiotelemetry system is an effective and efficient means of collecting left bank sonar data, controlling all aspects of equipment operation from the right bank.
- 5) Species differentiation based solely on dual-beam data will likely not occur at this site due to the inability to adequately separate individual fish in dense schools.

Future investigations and changes to operations should include:

- 1) Gillnet sampling in midriver areas should be continued, with deeper nets used in this area and on the left bank.
- 2) Dual-beam data collection and analysis of artificial target data should be continued to provide an inseason check of the performance stability of each calibrated sonar system and ultimately effective display threshold levels.
- 3) A transducer with a 15° beam should be installed to more completely ensonify the cross-sectional area of the left bank.

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Table 1. Estimated fish passage by species, at the Noatak River sonar site from 22 July through 10 September, 1994.

Report Period Ending ^a	Period Total Passage	Estimated Percent of Total				Estimated Report Period Passage			
		Chum	Char	Whitefish	Other	Chum	Char	Whitefish	Other
26JUL94 ^b	8,533	50	1	43	6	4,266	85	3,669	512
29JUL94 ^b	19,495	73	1	25	1	14,231	195	4,874	195
02AUG94	16,831	86	1	12	1	14,474	168	2,020	168
05AUG94	19,172	79	0	16	5	15,146	0	3,068	959
09AUG94	33,149	94	1	5	0	31,160	331	1,657	0
12AUG94	11,839	80	0	20	0	9,471	0	2,368	0
16AUG94	18,936	96	0	3	1	18,179	0	568	189
26AUG94 ^c	44,381	88	8	4	0	39,055	3,550	1,175	0
30AUG94	10,452	53	28	17	2	5,540	2,926	1,177	209
02SEP94	9,380	35	40	16	9	3,283	3,752	1,501	844
06SEP94	12,790	38	18	35	9	4,860	2,302	4,476	1,151
10SEP94	9,042	22	8	70	0	1,989	1,989	6,329	0
	-----	---	---	----	---	-----	-----	-----	-----
Total	214,000					161,663	14,062	33,982	4,293
s.e.						14,026	2,218	3,607	1,591
s.e./total						0.087	0.158	0.106	0.371
Overall %		75	7	16	2				

^a Fish passage and estimated species percentages for the entire river are calculated by multiple day reporting periods. Periods were decided upon by the area staff for timely inseason use.

^b Left bank daily counts were extrapolated from right bank daily counts using the average ratio of left bank daily counts to right bank daily counts between 30 July and 5 August.

^c Right bank daily counts from 18-22 August were interpolated from right bank data collected on 17 and 23 August. Left bank daily counts from 18-22 August were interpolated from left bank data collected on 17 and 25 August. Left bank daily counts for 23 and 24 August were extrapolated from right bank daily counts using the average ratio of left bank counts to right bank counts between 14-17 August and 25 and 26 August.

Table 2. Historical migratory run timing statistics for chum salmon, char, and whitefish at the Noatak River sonar site by year, 1990-1994.

Species	Year	Dates of Operation	Date of 25 % Passage	Date of 50 % Passage	Date of 75 % Passage
Chum salmon	1990	22 Jul-28 Aug	2 Aug	11 Aug	17 Aug
	1991	10 Jul-30 Aug	4 Aug	14 Aug	18 Aug
	1992	27 Jul-29 Aug	10 Aug	17 Aug	22 Aug
	1993	18 Jul-13 Sep	9 Aug	16 Aug	26 Aug
	1994	22 Jul-10 Sep	4 Aug	9 Aug	21 Aug
Arctic char	1990	22 Jul-28 Aug	17 Aug	21 Aug	24 Aug
	1991	10 Jul-30 Aug	14 Aug	17 Aug	19 Aug
	1992	27 Jul-29 Aug	17 Aug	20 Aug	22 Aug
	1993	18 Jul-13 Sep	12 Aug	19 Aug	22 Aug
	1994	22 Jul-10 Sep	25 Aug	30 Aug	2 Sep
Whitefish	1990	22 Jul-28 Aug	26 Jul	5 Aug	15 Aug
	1991	10 Jul-30 Aug	21 Jul	28 Jul	14 Aug
	1992	27 Jul-29 Aug	1 Aug	5 Aug	13 Aug
	1993	18 Jul-13 Sep	2 Aug	8 Aug	20 Aug
	1994	22 Jul-10 Sep	29 Jul	11 Aug	4 Sep

Table 3. Mean length, standard deviation, and sample size of chum salmon, Arctic char, and whitefish caught at the Noatak River sonar site by year, 1990-1994.

Species	Year	Mean Length ^a (mm)	Standard deviation	n
Chum salmon	1990	593	39.21	398
	1991	594	37.25	707
	1992	564	36.69	686
	1993	579	40.26	1044
	1994	572	35.81	1462
Arctic char ^b	1990	421	77.92	172
	1991	465	99.62	52
	1992 <430mm	356	40.43	161
	1992 >430mm	528	47.65	139
	1993	419	115.21	362
	1994	410	92.72	140
Whitefish	1990	334	20.40	93
	1991	347	31.33	129
	1992	345	30.63	185
	1993	348	35.07	229
	1994	342	35.61	257

^a Chum salmon were measured mid-eye to tailfork; Arctic char and whitefish were measured snout to tailfork.

^b All three species had a unimodal length distribution for all years except 1992. Length distributions of Arctic char had a pronounced bimodal distribution in 1992.

Table 4. Estimated seasonal proportions of chum salmon, char, and whitefish passing on the right bank at the Noatak River sonar site, 1990-1994.

Species	Year	Dates of Operation	Estimated Proportion	Estimated Passage	Sonar Sampling Range (m)
Chum salmon	1990	22 Jul-28 Aug	0.62	41,948	20-100
	1991	10 Jul-30 Aug	0.75	82,612	0-120
	1992	27 Jul-29 Aug	0.48	70,379	20-120
	1993	18 Jul-13 Sep	0.64	117,545	20-180
	1994	22 Jul-10 Sep	0.76	161,663	0-180
Arctic char	1990	22 Jul-28 Aug	0.24	16,144	20-100
	1991	10 Jul-30 Aug	0.09	10,329	0-120
	1992	27 Jul-29 Aug	0.30	44,585	20-120
	1993	18 Jul-13 Sep	0.16	30,674	20-180
	1994	22 Jul-10 Sep	0.06	14,062	0-180
Whitefish	1990	22 Jul-28 Aug	0.09	6,437	20-100
	1991	10 Jul-30 Aug	0.12	12,815	0-120
	1992	27 Jul-29 Aug	0.18	25,802	20-120
	1993	18 Jul-13 Sep	0.19	35,025	20-180
	1994	22 Jul-10 Sep	0.16	33,982	0-180

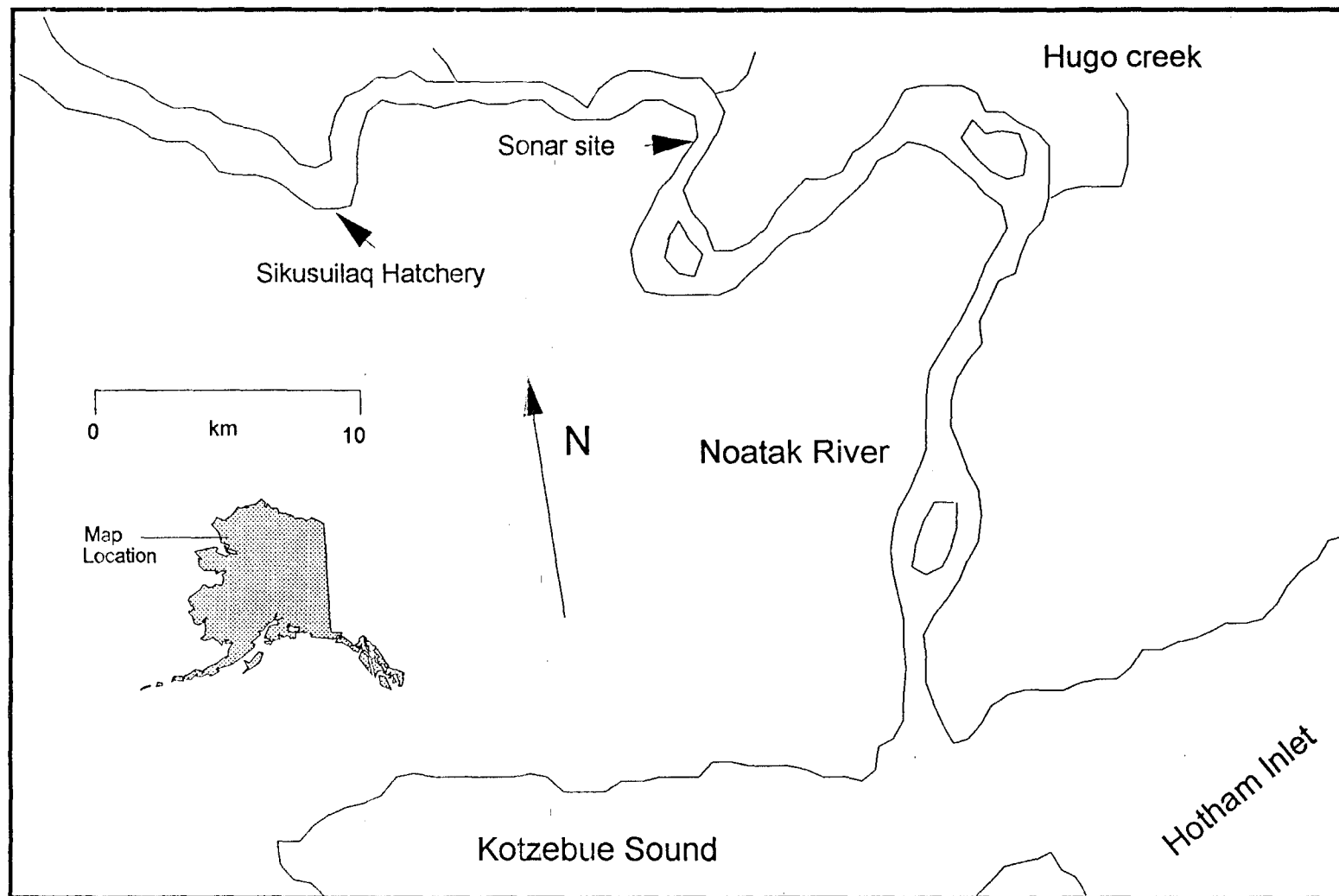


Figure 1. Location of Noatak River sonar at km 39, 1989-present.

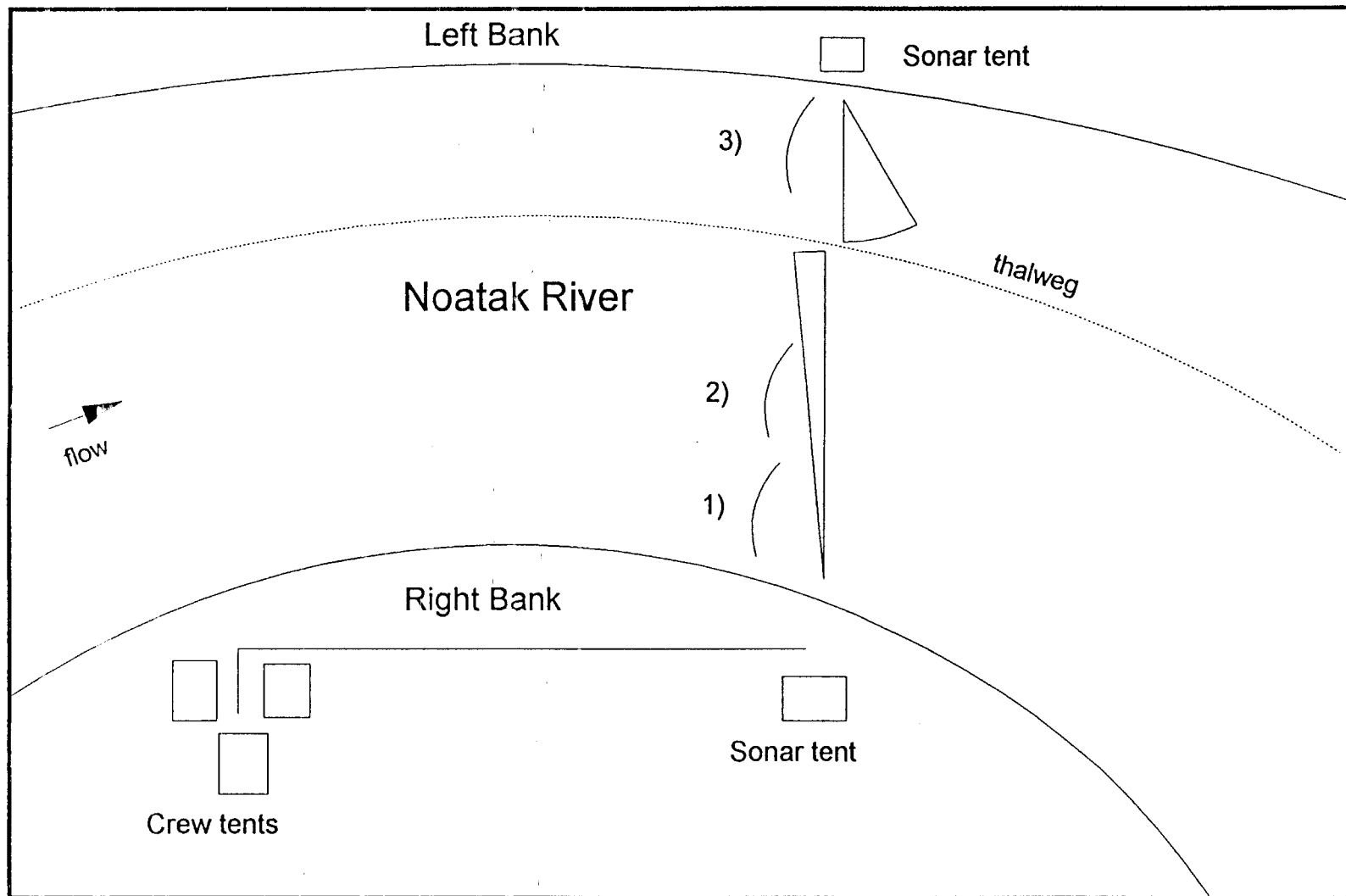


Figure 2. Aerial view of sonar sampling area and drift gillnet stations 1) right bank nearshore, 2) midriver, and 3) left bank nearshore, Noatak River sonar, 1994. (Drawing not to scale).

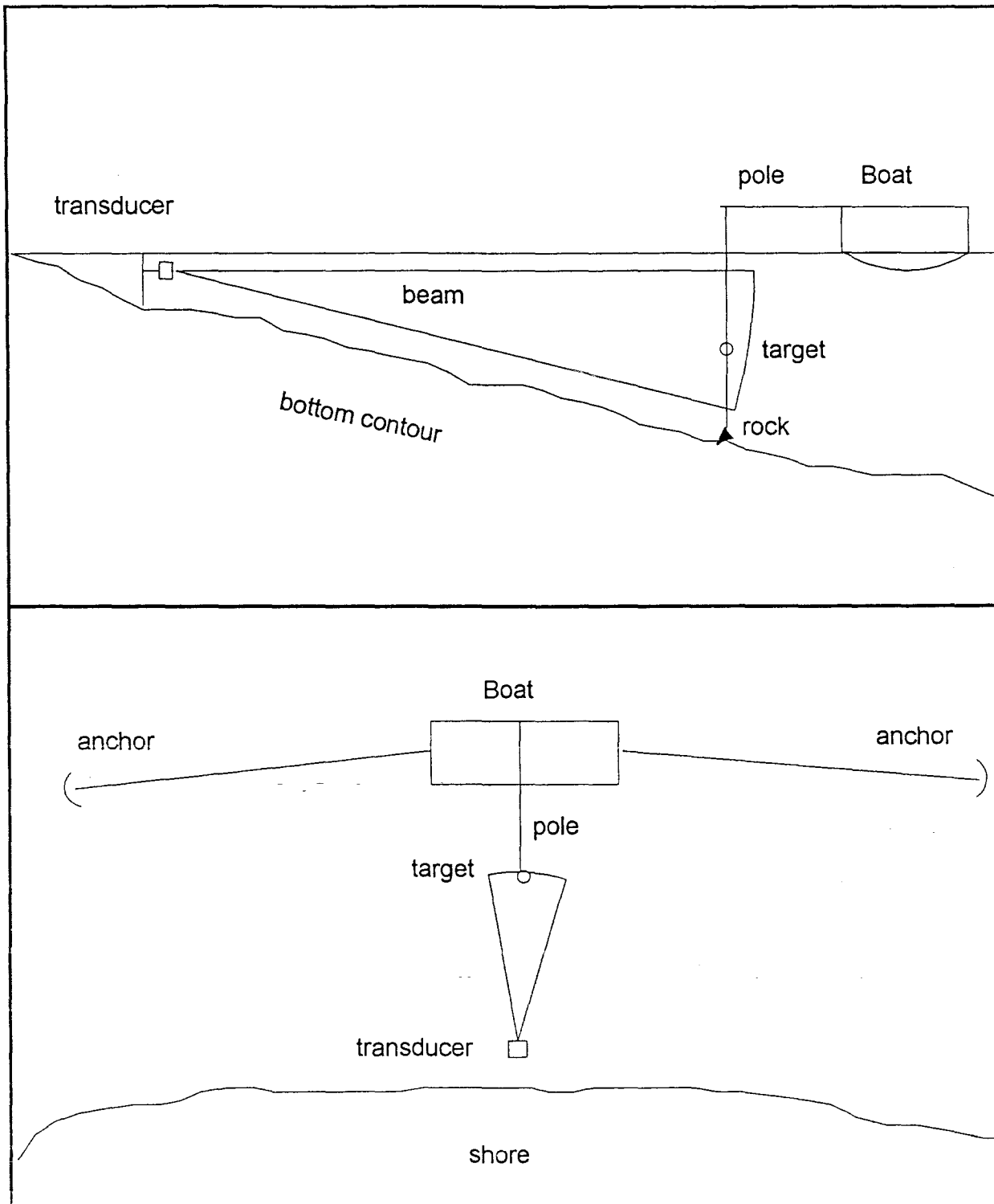


Figure 3. Two schematic views of artificial target deployment at Noatak River sonar.

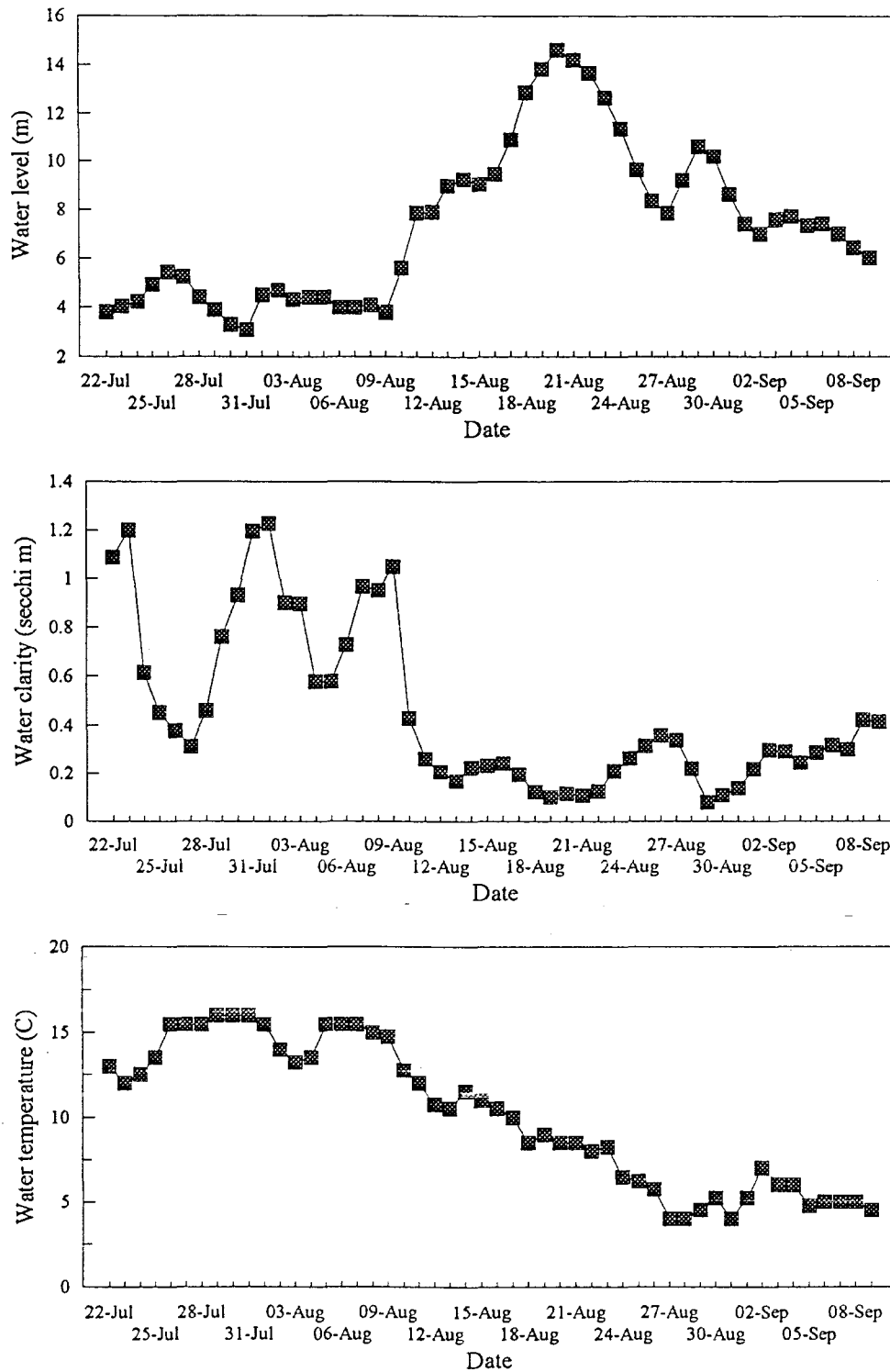


Figure 4. Water level, clarity, and temperature from 22 July through 10 September, Noatak River sonar, 1994.

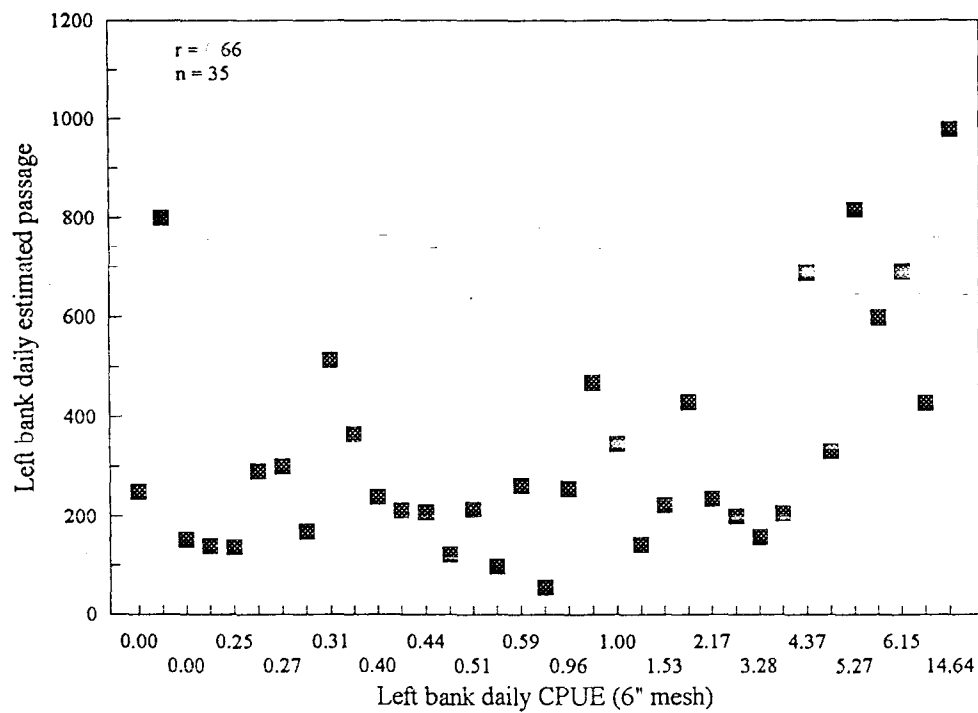
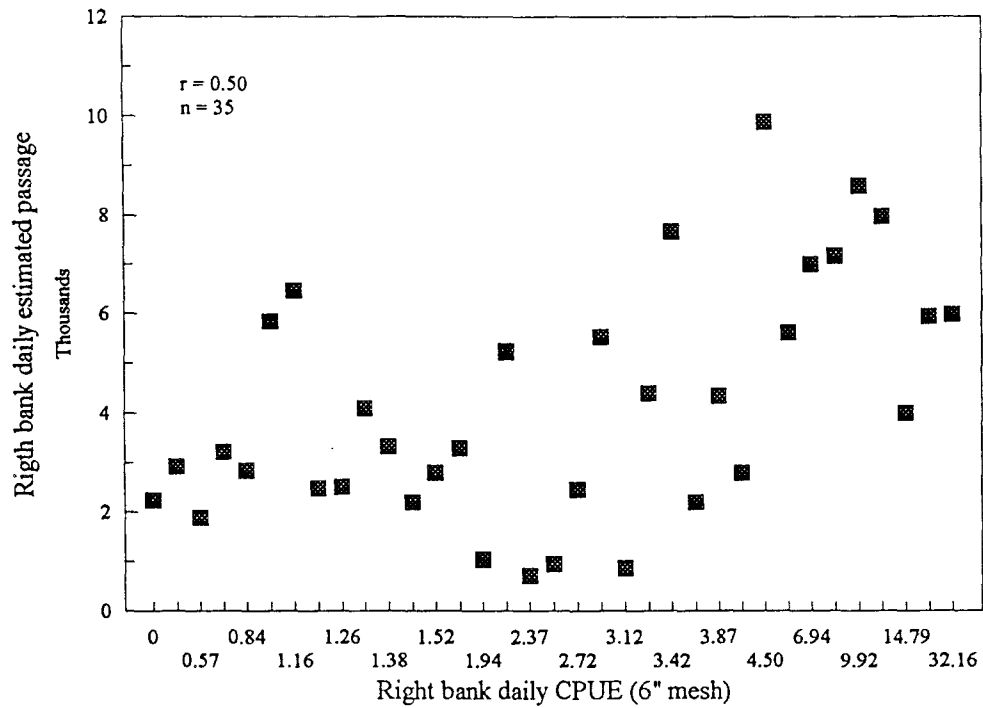


Figure 5 . Comparison of daily chum salmon CPUE from the 6" mesh net versus daily total estimated fish passage from the right and left banks of the Noatak River from 30 July through 9 September, 1994.

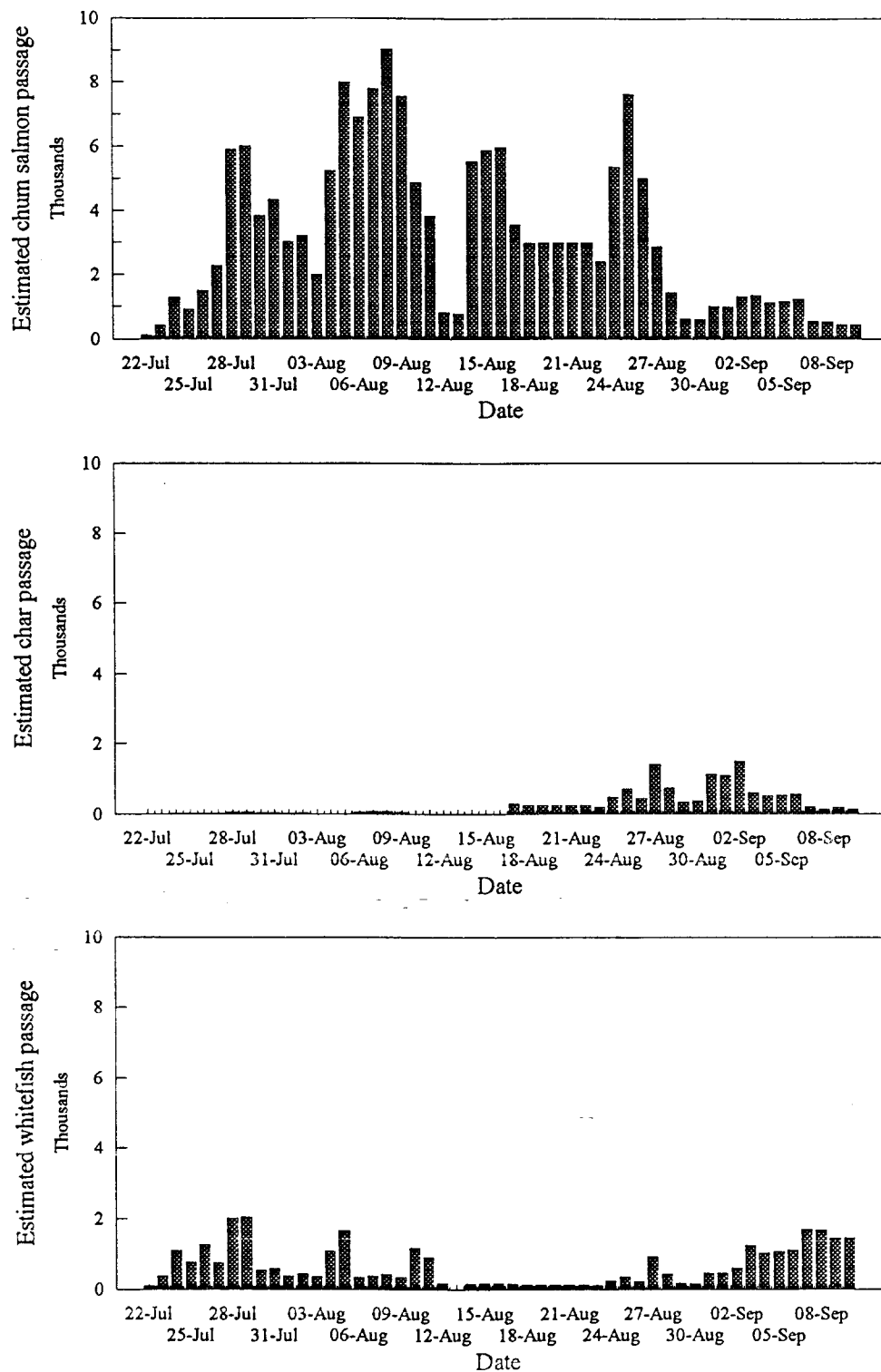


Figure 6. Daily passage estimates of chum salmon, char, and whitefish from 22 July through 10 September, Noatak River sonar, 1994.

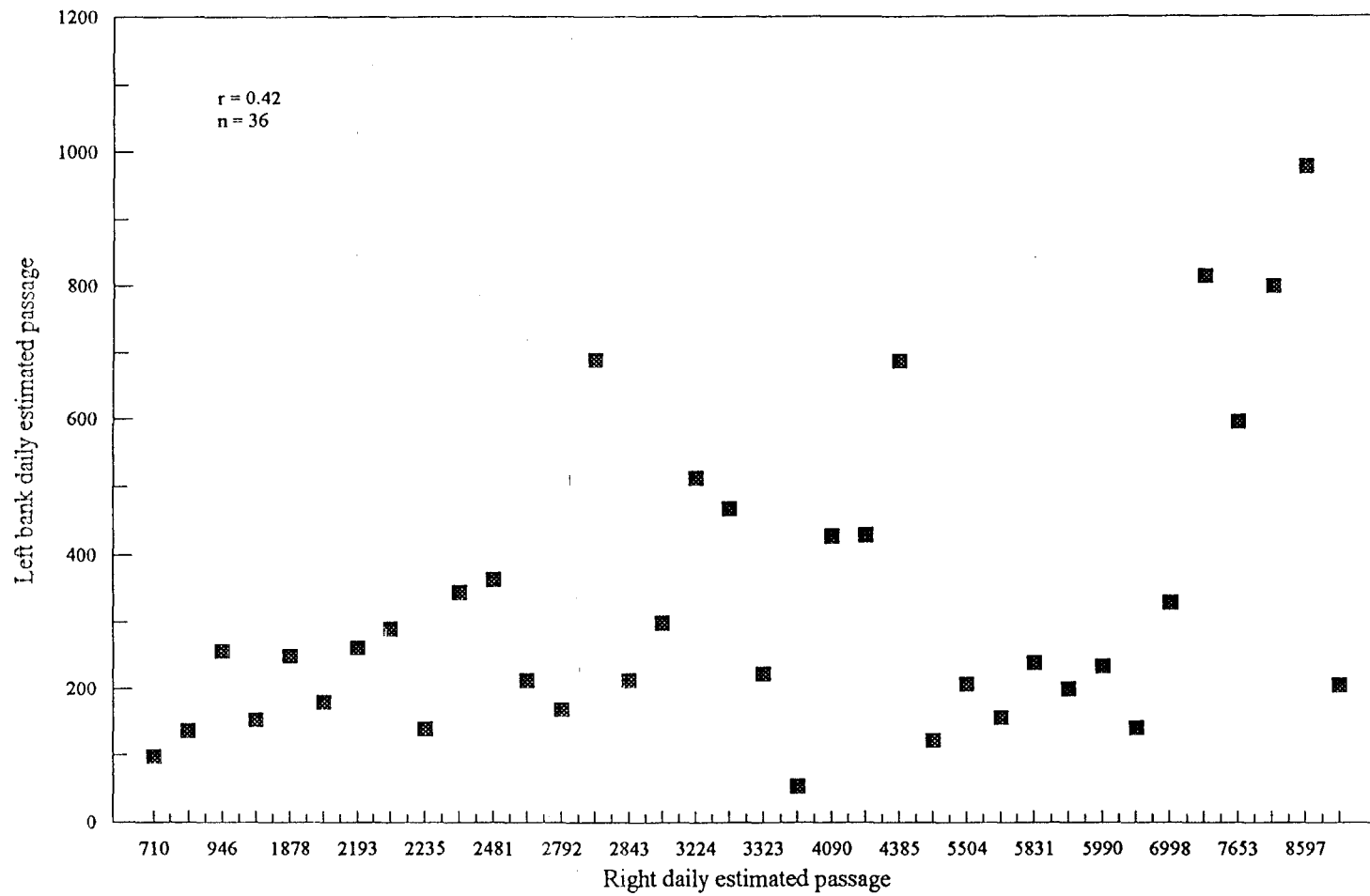


Figure 7. Comparison of daily total estimated fish passage on the right and left banks of the Noatak River. Data are representative of days between 30 July and 10 September, 1994, when sonar on both banks were operating simultaneously.

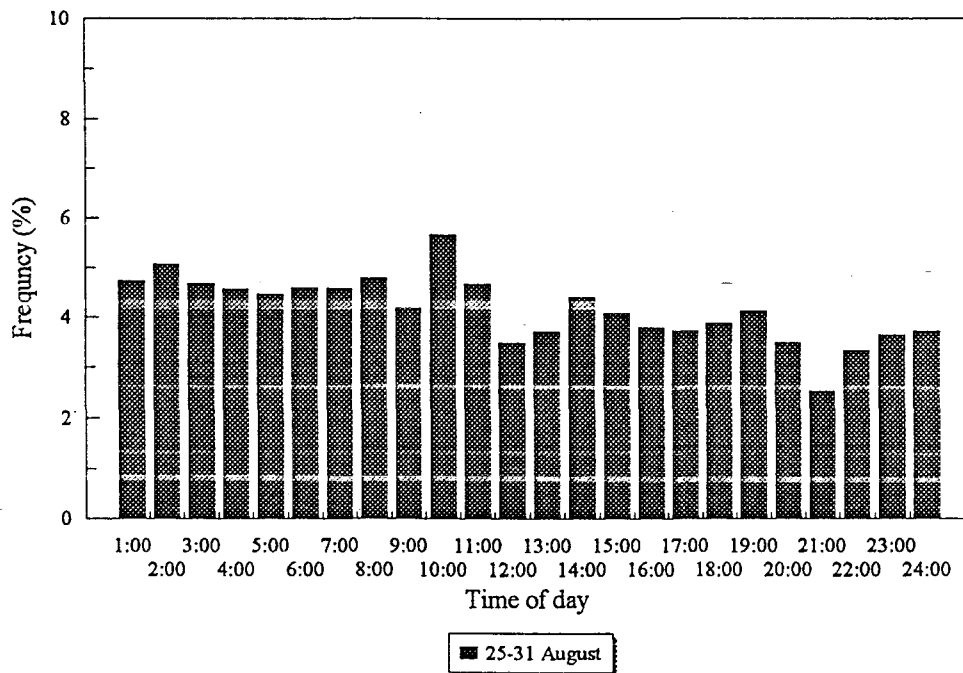
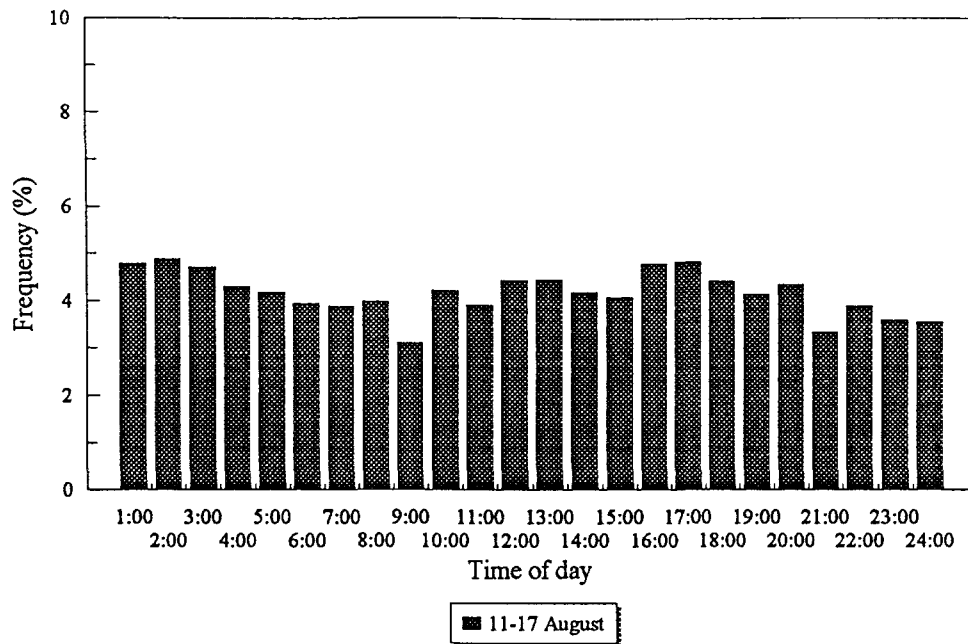


Figure 8. Diel distribution of fish migration during two periods of data collection when water clarity (secchi) < 1 m. Both sets of data are from 7 day periods of continuous 24 h data in August, Noatak River sonar, 1994.

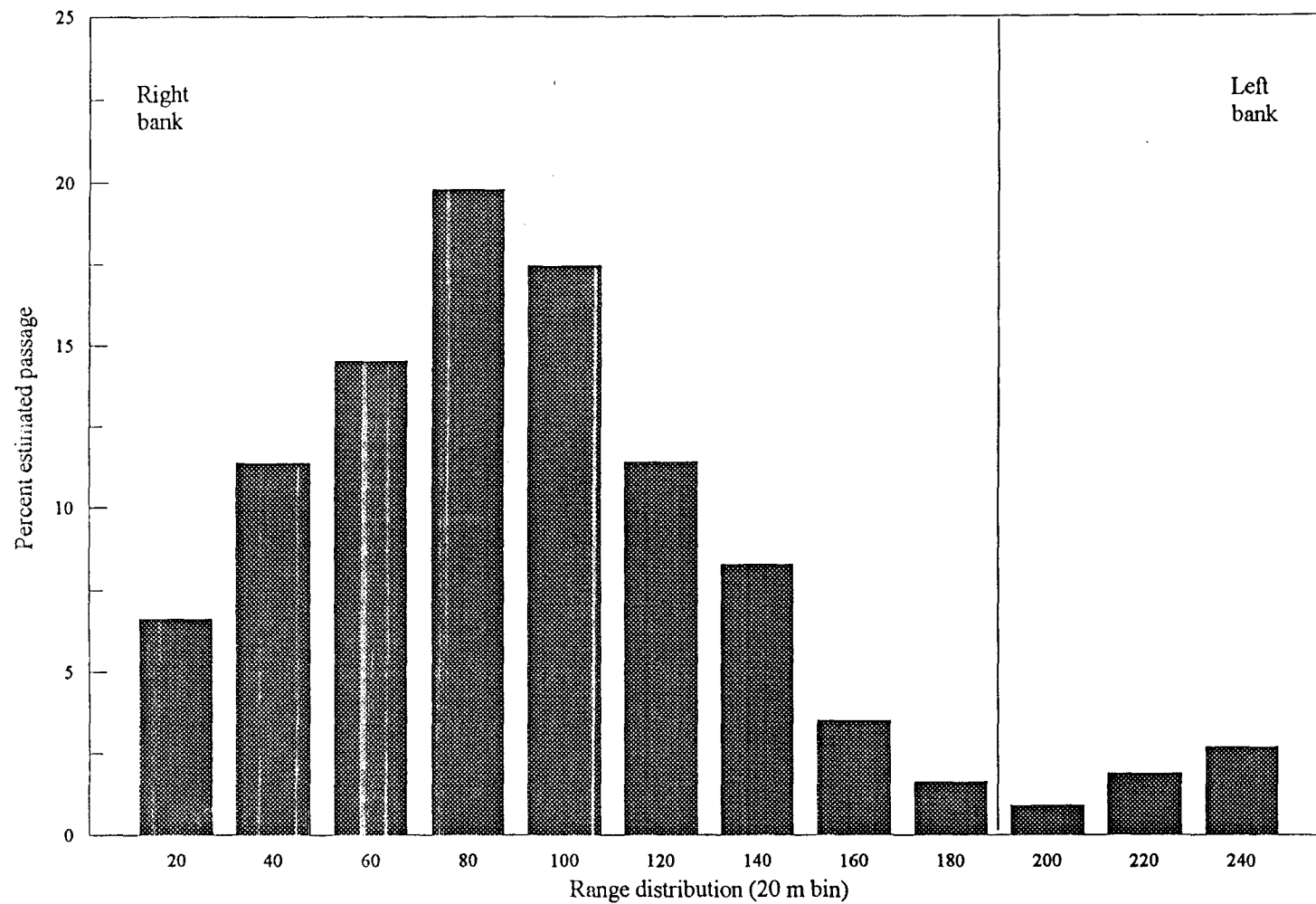


Figure 9. Horizontal range distribution of raw count data from the right bank of the Noatak River, 22 July through 10 September, 1994.

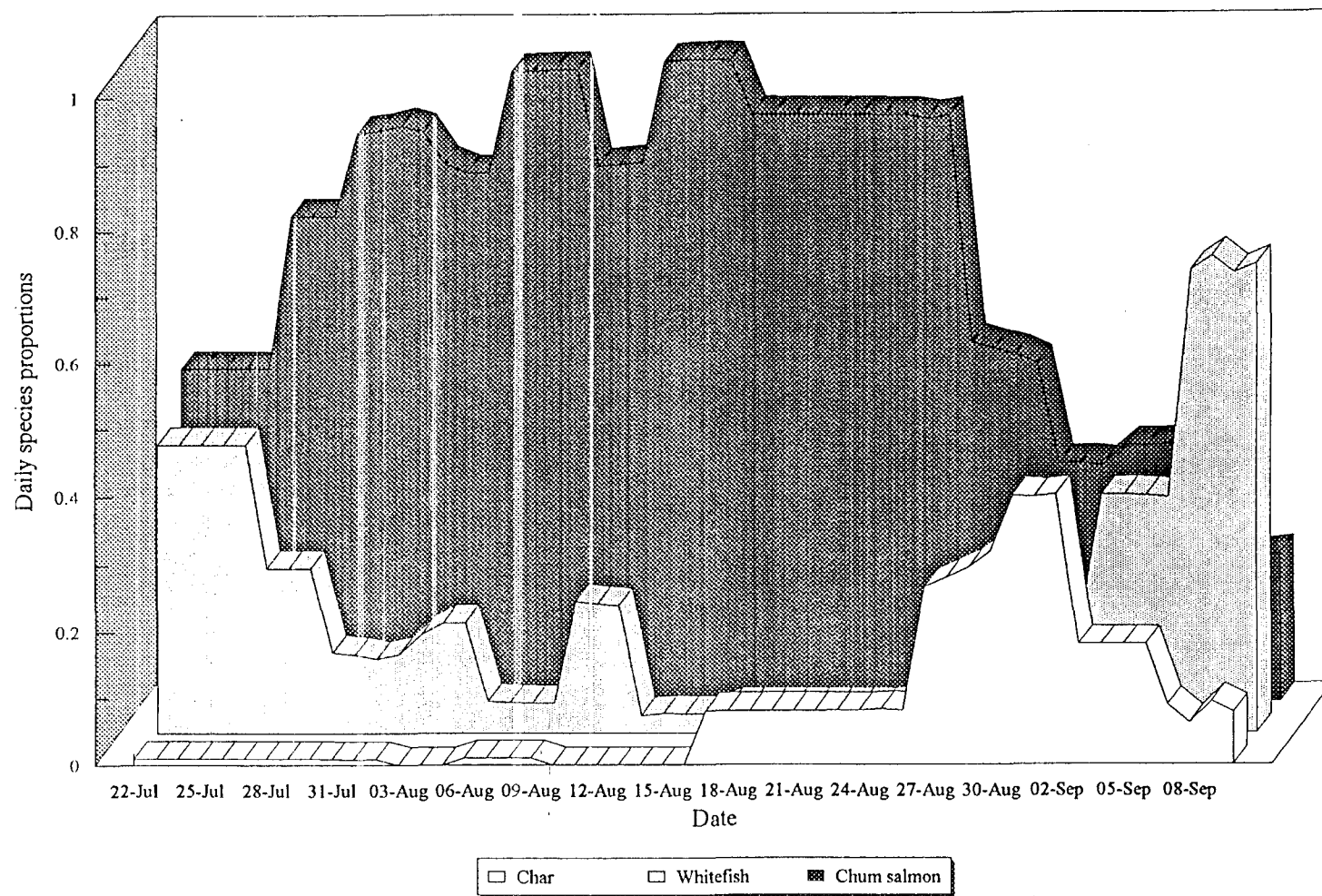


Figure 10. Estimated daily proportions of chum salmon, char, and whitefish from 22 July through 10 September, Noatak River sonar, 1994.

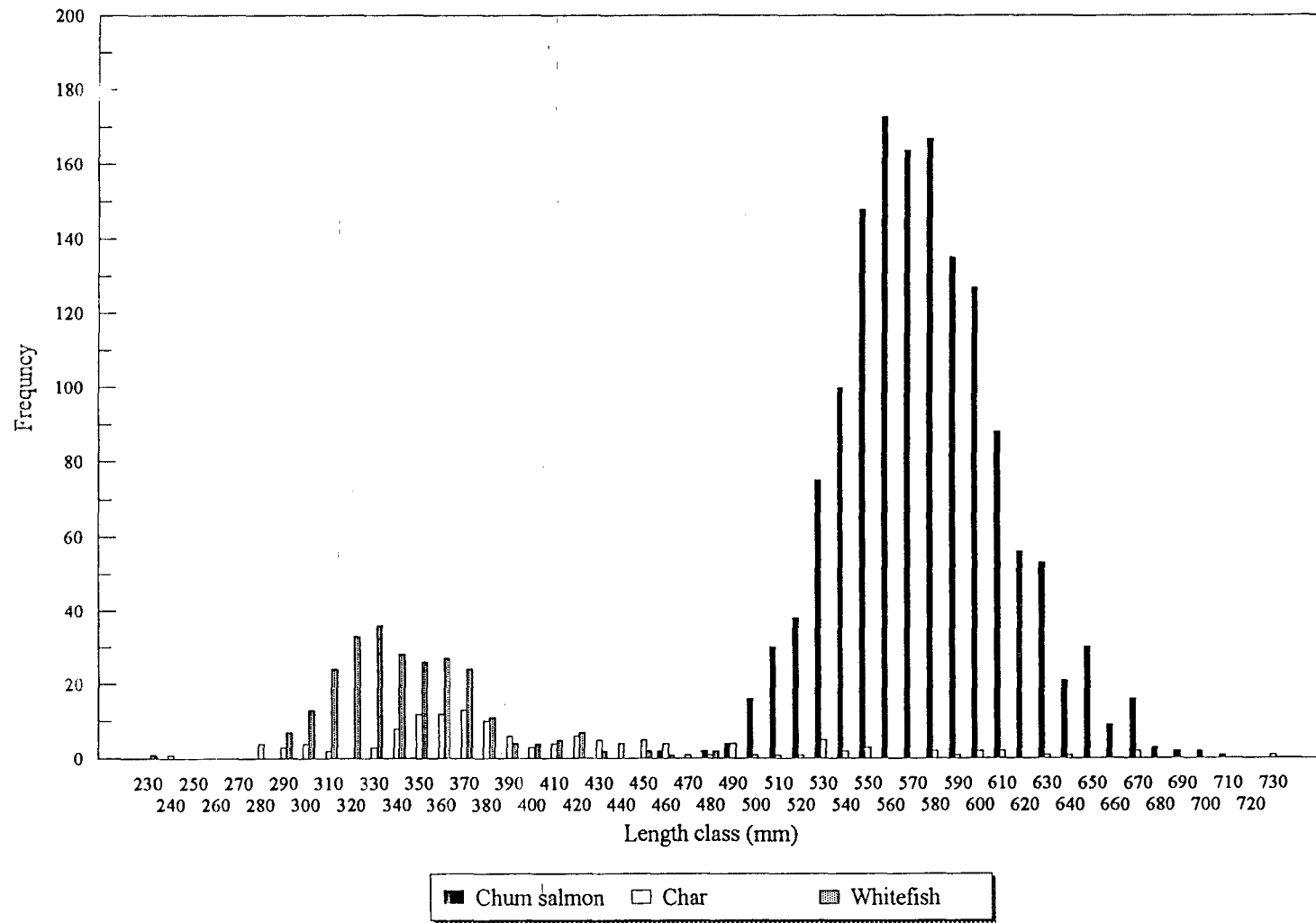


Figure 11. Length class distribution of chum salmon, char, and whitefish captured at Noatak River sonar, 1994.

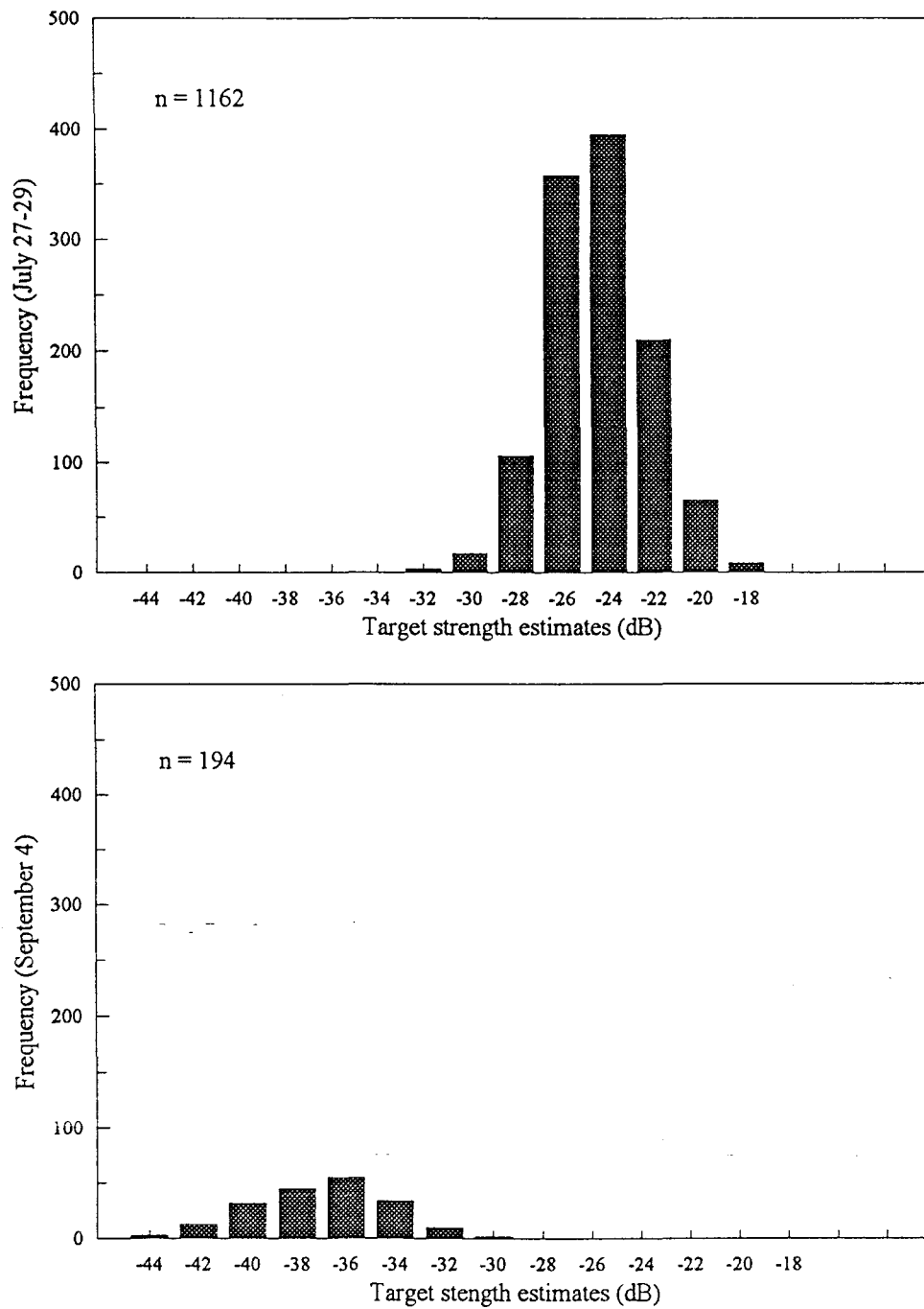


Figure 12. Target strength estimates of individual fish migrating on 27-29 July and 4 September, 1994, Noatak River sonar.

APPENDIX

Appendix A. Mesh size parameter file used by SAS program to determine relative abundance of fish species present in the Noatak River.

SPECME93.NTK: sets which meshes will be used (by NOATAK93.SAS) to estimate CPUE for each species and also sets which species' catches will be adjusted for net selectivity.

A "1" in the column for a given mesh indicates that fish of that species caught in that mesh will be used to calculate relative CPUE and in turn allocate sonar counts to species.

A "Y" in the ADJUST column will cause the program to adjust catches of that species for net selectivity, a "N" will cause the program to not adjust.

	2.75	4.0	5.0	5.5	6.0	ADJUST?
CHINOOK	0	0	0	0	1	N
CHUM	0	0	1	0	1	Y
CHARR	1	1	1	0	1	Y
PIKE	0	0	1	0	1	N
PINK	0	1	1	0	0	Y
SHEEFISH	1	1	0	0	0	N
WHITE	1	0	0	0	0	N
FLOUNDER	0	0	1	0	1	N
OTHER	1	1	0	0	0	N
CISCO	1	0	0	0	0	N
NONE	0	0	0	0	0	N

Appendix B. Net selectivity parameter file used by SAS program. Selectivity coefficients were calculated from drift gillnet data collected in 1991-92 at the Noatak River sonar site.

NETSEL93.NTK: source of net selectivity estimates for NOATAK93.SAS
 Values are read from specific columns:

SPECIES	LENGTH	2.75"	4.0"	5.0"	5.5"	6.0"
CHUM	440			0.768		
CHUM	480		0.256	0.950		
CHUM	520			0.957		0.564
CHUM	560			0.452		0.866
CHUM	600			0.279		1.000
CHUM	640					0.887
CHUM	680					0.633
CHUM	720					0.633
CHARR	320	0.941				
CHARR	360	0.758	0.794			
CHARR	400	0.248	0.967			
CHARR	440	0.175	0.993	0.676		
CHARR	480		0.792	0.915		
CHARR	520		0.836	0.995		0.374
CHARR	560		0.615	0.908		0.981
CHARR	600		0.645	0.967		0.530
CHARR	640					1.000
PINK	320		0.723			
PINK	360		0.662			
PINK	400		0.979			
PINK	440		0.855	0.912		0.160
PINK	480		0.892	0.892		0.382

Appendix C. SAS data processing program.

```
title1 'Noatak Sonar In-Season Data Processing Program, 1994, RIGHT BANK';

*IDENTIFY PATH OF DIRECTORY IN WHICH TO STORE PERMANENT SAS DATA SETS;
libname save '\sassave';

*SET PAGE LENGTH AND WIDTH FOR OUTPUT;
options linesize=79;
options pagesize=60;

*READ IN POOLING VARIABLE AND SONAR PASSAGE ESTIMATES, ONE LINE PER DAY;

data rperiod;
    infile '94rbper.dat' firstobs=7;
    informat date mmddyy8.;
    input reportno date rpassage;
    format date date7.;
    run;

title2 'Sonar estimates of daily RIGHT BANK fish passage';
title3 '0m to 180m range';

proc print noobs data=rperiod;
    var reportno date rpassage;
    sum rpassage;
    run;

*SUM SONAR PASSAGE ESTIMATES FOR ALL DAYS IN THE REPORT PERIOD;

proc summary data=rperiod;
    by reportno;
    var RPASSAGE;
    output out=reptpasg sum=passage;
    run;

*
*
*THIS CONCLUDES CALCULATIONS FOR THE SONAR DATA, NOW BEGIN TESTFISH DATA
PROCESSING;
*
*
*

*READ DATA FROM RBASE EXPORT FILE, ONE LINE FOR EACH FISH, PLUS ONE LINE FOR
ANY DRIFTS DURING WHICH NO FISH WERE CAUGHT;
*CALCULATE EFFORT IN FATHOM HOURS;
```

-Continued-

*NOTE THERE IS NO CONTINGENCY FOR DRIFTS SPANNING MIDNIGHT;

```
data nltfish;
  length qmeth qsex $3;
  length meth sex $1;
  length species $8;
  infile 'e:\rbfiles\NRBTFISH.dlm' delimiter=',';
  informat date mmdyy. startout fullout startin fullin time8.;
  format date date7. startout fullout startin fullin time5.;
  input date tperiod site mesh fathoms qmeth rangel range2
    startout fullout startin fullin spcode qsex length;
  meth=upcase(substr(qmeth,2,1));
  sex=upcase(substr(qsex,2,1));
  drifsecs = (startin-fullout) + (fullout-startout)/2 + (fullin-startin)/2;
  fathhrs= fathoms*drifsecs/3600;
  IF LENGTH=0 THEN LCLASSMP=0; ELSE LCLASSMP= ROUND(LENGTH,40);
  if spcode=0 then catch=0; else catch=1;
  drop qmeth qsex fullout startin fullin drifsecs;
  if spcode = 1 then species = 'CHINOOK ';
  if spcode = 2 then species = 'CHUM';
  if spcode = 3 then species = 'CHARR';
  if spcode = 4 then species = 'PIKE';
  if spcode = 5 then species = 'PINK';
  if spcode = 6 then species = 'SHEEFISH';
  if spcode = 7 then species = 'WHITE';
  if spcode = 8 then species = 'FLOUNDER';
  if spcode = 9 then species = 'OTHER';
  if spcode = 10 then species = 'CISCO';
  if spcode = 0 or spcode = . then species = 'NONE';
  if mesh=2.75 then meshcode=1;
  if mesh=4 then meshcode=2;
  if mesh=5 then meshcode=3;
  if mesh=5.5 then meshcode=4;
  if mesh=6 then meshcode=5;
run;

*MERGE REPORT PERIOD INFO WITH TESTFISH DATA FILE;
proc sort data=nltfish; by date; run;
data nltfish; merge nltfish(in=a) rperiod; by date; if a; run;

*GENERATE CPUE DATA FOR COMPARISON WITH DOWNRIVER TESTFISH PROJECT;
data tfishrpt; set nltfish;
  if spcode eq 1 then delete;
```

-Continued-

```
if spcode gt 2 then delete;
if meshcode eq 5 or meshcode eq 3;
run;

proc sort data=tfishrpt; by mesh date startout;
proc summary data=tfishrpt;
  var fathhrs catch;
  output out=drifcpue mean(fathhrs)=drifteff sum(catch)=drifctch;
  by mesh date startout; run;

proc summary data=drifcpue;
  var drifteff drifctch;
  output out=daycpue sum=dayeff daycatch;
  by mesh date; run;

data daycpue; set daycpue;
  if dayeff gt 0 then daycpue=daycatch/dayeff;
  else daycpue=0;
  format date date7. dayeff daycpue 7.2 daycatch 7.0;
  label dayeff='FATHOM HOURS' daycatch='NUMBER CAUGHT' daycpue='CPUE';
run;

title2 'DAILY RIGHT BANK CHUM SALMON CATCH, EFFORT, AND CPUE, BY MESH';
title3 'no adjustments made for net selectivity';
proc print data=daycpue noobs label;
  var date daycatch dayeff daycpue;
  by mesh;
run;

*CALCULATE EFFORT PER MESH;
proc sort data=nltfish; by date tfperiod mesh startout species; run;
proc summary data=nltfish;
  var fathhrs; id meth rangel range2;
  output out=drifsets mean(fathhrs)=effort;
  by date tfperiod mesh startout;
run;

*AND CATCH PER MESH PER SPECIES;
proc summary data=nltfish;
  var catch; id meth rangel range2;
  output out=ds2 sum(catch)=sppcatch;
  by date tfperiod mesh startout species;
run;
```

-Continued-

```
proc sort data=ds2; by date tfperiod mesh startout meth rangel range2; run;
proc transpose data=ds2 out=tfsummar;
  by date tfperiod mesh startout meth rangel range2;
  var sppcatch;
  id species;
run;

data tfsummar; merge tfsummar drifsets; by date tfperiod mesh startout;
  drftmins=effort*60/25;
run;

data spplist;
  chum=0; charr=0; pink=0; white=0; run;

data tfsummar; set tfsummar (in=a drop=_type_ _freq_) spplist;
  if a;
  format date date7. startout time5. effort 8.2;
  label effort='FATHOM HOURS' drftmins='MINUTES DEPLOYED';
run;

proc sort data=tfsummar; by date meth mesh startout; run;
title2 'SUMMARY OF RIGHT BANK TESTFISH RESULTS';
title3 'only major species listed';
proc print data=tfsummar label noobs;
  var date tfperiod startout meth mesh;
  sum drftmins chum charr pink white;
run;

*AND THEN BY SUMMING EFFORT FOR ALL DRIFTS IN A TFPERIOD WITH A GIVEN MESH;
data drifsets; set drifsets; if meth='D'; run;
proc sort data=drifsets; by date tfperiod mesh; run;
proc summary data=drifsets;
  var effort;
  output out=effort1 sum=meffort; *(MESH EFFORT);
  by date tfperiod mesh;
run;

*FINALLY, REARRANGE DATA TO PUT EFFORTS FOR ALL MESHES ON A SINGLE LINE;
proc transpose data=effort1 out=effort2;
  var meffort; id mesh;
  by date tfperiod;
run;
data effort2; set effort2(drop=_name_);
  rename _2d75 =effort1;
  rename _4 =effort2;
```

-Continued-

```
rename _5      =effort3;
rename _5d5    =effort4;
rename _6      =effort5;
format date date7.;
run;

/*
TITLE2 'WORK.EFFORT2';
PROC PRINT; RUN;
*/

*READ IN AN EXTERNAL FILE WHICH SETS WHICH MESHES WILL BE USED TO ESTIMATE
CPUE FOR EACH SPECIES, AND WHICH SPECIES CATCHES WILL BE ADJUSTED FOR NET
SELECTIVITY;
data specmesh;
    infile 'specme93.ntk' firstobs=17;                *PATH;
    length species $ 8;
    length adjust $ 3;
    input species usemesh1-usemesh5 adjust;
run;

*MERGE SPECIES-MESH PAIRING DATA INTO TESTFISH DATA SET;
*DELETE FISH WHICH WERE NOT CAUGHT IN MESHES TARGETING THAT SPECIES;
proc sort data=nltfish; by species; run;
proc sort data=specmesh; by species; run;
data tfsm;
    merge nltfish(in=a) specmesh;
    by species;
    if a;
    array usemesh{5} usemesh1-usemesh5;
    if usemesh{meshcode}=0 then delete;
run;

/*proc datasets library=work; delete testfish; run;*/

*MERGE NET SELECTIVITY CURVE DATA INTO TESTFISH (+SM) DATA SET;
data netselec;
    infile 'netsel93.ntk' missover firstobs=5;
    length species $7.;
    input @5 species lclassmp 13-16 prob1 18-22 prob2 24-28
                                prob3 30-34 prob4 36-40 prob5 42-46;
run;

proc sort data=tfsm; by species lclassmp; run;
```

-Continued-

```
proc sort data=netselec; by species lclassmp; run;
data tfsmns; merge tfsm(in=b drop=fathrs) netselec; by species lclassmp;
  if b;
  run;
/*
*PRINT SELECTIVITY FILE;
title2 'NET SELECTIVITY ESTIMATES USED TO ADJUST CATCHES';
proc print label noobs data=netselec; run;
*/

/*proc datasets library=work; delete tfsm; run;*/

*MERGE EFFORT DATA INTO TESTFISH (+SM+NS) DATA SET;
*DECLARE ARRAYS;
proc sort data=tfsmns; by date tfperiod; run;
data tfsmnsef; merge tfsmns(in=c) effort2; by date tfperiod;
  if meth='D';
  if c;
  array usemesh{5} usemesh1-usemesh5;
  array prob{5} prob1-prob5;
  array effort{5} effort1-effort5;
  *FOR MAJOR SPECIES, ADJUST CATCH (I.E., 1 FISH) FOR NET SELECTIVITY;
  *IF NET SELECTIVITY IS NOT KNOWN FOR THIS SIZE CLASS, SET CATCH TO ZERO;
  meanprob=0.7;
  if adjust='N' then adjcatch=1/meanprob;
  else if adjust='Y' then do;
    if prob{meshcode} ne . then adjcatch=1/prob{meshcode};
    else if prob{meshcode} eq . then adjcatch=0;
  end;
  *SUM EFFORT FOR ALL MESHES TARGETING THIS SPECIES DURING THIS TF PERIOD;
  *IF SPECIES IS ADJUSTED FOR NET SELECTIVITY, THEN DO NOT CONSIDER THOSE
  MESHES FOR WHICH NET SELECTIVITY IS NOT KNOWN FOR THIS FISH;
  *FINALLY, CALCULATE ADJUSTED CPUE FOR EACH FISH;
  sumeff=0;
  do imesh=1 to 5;
    if adjust='Y' then do;
      if prob{imesh} = . then usemesh{imesh} = 0;
    end;
    if effort{imesh}= . then effort{imesh}=0;
    sumeff=sumeff+effort{imesh}*usemesh{imesh};
  end;
  adjcpue=adjcatch/sumeff;
format date date7. startout time5. prob1-prob5 3.2 adjcpue 4.3
  effort1-effort5 sumeff 4.1 adjcatch 5.2;
```

-Continued-

```
run;

/*proc datasets library=work; delete tfsmns; run;*/

/*
*OPTIONAL PRINTOUT FOLLOWS: SHOWS INTERMEDIARY CALCULATIONS ON TESTFISH DATA;
options linesize=120;
data print; set tfsmnsef;
title2 'PART OF DATA SET TFSMNSEF';
title3 'ONE LINE PER FISH, EACH LINE ALSO HAS INFORMATION ON NET SELECTIVITY';
title4 'CURVE PARAMETERS AND EFFORT FOR EACH MESH DRIFTED DURING THAT PERIOD';
run;
proc print data=print;
var date startout mesh species length lclassmp adjcatch
    probl-prob5 usemesh1-usemesh5 effort1-effort5 sumeff adjcpue;
run;
*/

*SUM ADJUSTED CPUE FOR EACH SPECIES DURING EACH TESTFISH PERIOD;
proc sort data=tfsmnsef; by reportno date tfperiod spcode;
proc summary data=tfsmnsef;
var adjcpue adjcatch; id startout species;
output out=spcpue sum=spcpue spcatch;
by reportno date tfperiod spcode;
run;

*TRANPOSE BY ALL BUT SPECIES (CODE), CREATING A SEPARATE VARIABLE FOR CPUE OF
EACH SPECIES;
proc transpose data=spcpue out=spcpwide;
by reportno date tfperiod;
var spcpue;
id spcode;
run;

proc summary data=spcpue;
by reportno date tfperiod;
var spcatch startout;
output out=catch sum(spcatch)=adjcatch mean(startout)=avestart;
run;

*SUM CPUE'S FOR ALL SPECIES DURING A GIVEN TESTFISH PERIOD;
data spcpwide; merge spcpwide catch; by reportno date tfperiod;
array cpue{10} _1-_10;
sumcpue=0;
```

-Continued-

```
do i=1 to 10;
  if cpue{i} = . then cpue{i} = 0;
  sumcpue= sumcpue + cpue{i};
end;
format date date7. avestart time5. _1-_10 adjcatch sumcpue 6.2;
run;

/*
*OPTIONAL PRINTOUT FOLLOWS;
title2 'INTERMEDIARY DATA SET WORK.SPCPWIDE: CPUE BY SPECIES CODES'; run;
proc print data=spcpwide noobs label;
  var reportno date tfperiod adjcatch _1-_10 sumcpue;
run;
*/
/*
*CREATE OPTIONAL BAR CHART OF SPECIES CPUE BY TESTFISH PERIOD;
data chartcp; merge spcpue catch; by reportno date tfperiod;
  datetime=dhms(date,hour(avestart),minute(avestart),0);
  format datetime datetime10.;
  label datetime='DATE AND HOUR';
  if spcode<2 or spcode=4 or spcode=6 or spcode>7 then delete;
run;
title2 'TESTFISH CPUE, BY SPECIES, IN ALL TESTFISH PERIODS';
proc chart data=chartcp;
  vbar datetime / sumvar=spcpue subgroup=species discrete;
run;
*/
*SUM CPUE, FOR EACH SPECIES AND FOR ALL SPECIES, ACROSS ALL TESTFISH PERIODS
  WITHIN EACH REPORTING PERIOD;
*CALCULATE THE AVERAGE TOTAL (ALL SPECIES) CPUE IN EACH REPORT PERIOD;
*COUNT THE NUMBER OF TESTFISH PERIODS IN EACH REPORT PERIOD;
proc sort data=spcpwide; by reportno; run;
proc summary data=spcpwide;
  var _1-_10 sumcpue;
  output out=rncpue sum=rnspcp1-rnspcp10 rnsmp
           mean(sumcpue)=rnmncp
           n=n;

  by reportno;
run;

*MERGE THE ORIGINAL DATA SET WITH THE SUMMARIZED DATA SET, THEN CALCULATE:
  ESTIMATED PROPORTION OF EACH SPECIES DURING EACH TESTFISH PERIOD,
  ESTIMATED PROPORTION OF EACH SPECIES DURING EACH REPORT PERIOD,
  AND A WEIGHTED SQUARED DEVIATION OF THE TESTFISH PERIOD PROPORTION FROM
```

-Continued-

```
THE REPORT PERIOD PROPORTION;
data varcalc;
  merge spcpwide rncpue;
  by reportno;
  array cpue{10} _1-10;
  array rnspcp{10} rnspcp1-rnspcp10;
  array phatpr{10} phatpr1-phatpr10;
  array phatrp{10} phatrp1-phatrp10;
  array sqrdev{10} sqrdev1-sqrdev10;
  weight=sumcpue/rnmncp;
  do i=1 to 10;
    phatpr{i}=cpue{i}/sumcpue;
    phatrp{i}=rnspcp{i}/rnsmp;
    sqrdev{i}=(weight**2)*(phatpr{i}-phatrp{i])**2;
  end;
  label phatpr1='CHINOOK' phatpr2='CHUM' phatpr3='CHARR' phatpr4='PIKE'
  phatpr5='PINK' phatpr6='SHEEFISH' phatpr7='WHITE' phatpr8='FLOUNDER'
  phatpr9='OTHER' phatpr10='CISCO';
  format phatpr1-phatpr10 3.2;
  format adjcatch 5.0;
  format date date7. avestart time5.;
run;

*OPTIONAL PRINTOUT OF SPECIES PROPORTIONS BY TESTFISH PERIOD;
options linesize=120;
proc sort data=varcalc; by reportno date tfperiod;
title2 'ESTIMATED RIGHT BANK SPECIES PROPORTIONS AND TOTAL ADJUSTED CATCH BY
TESTFISH PERIOD';
run;
proc print label data=varcalc;
  var reportno date adjcatch
    phatpr1 phatpr2 phatpr3 phatpr4 phatpr5
    phatpr6 phatpr7 phatpr8 phatpr9 phatpr10;
run;

*SUM THE SQUARED DEVIATIONS BY REPORT PERIOD;
proc sort data=varcalc; by reportno; run;
proc summary data=varcalc;
  var sqrdev1-sqrdev10 adjcatch;
  id phatpr1-phatpr10 n date;
  output out=varprop sum=smsqdv1-smsqdv10 adjcatch;
  by reportno;
run;
```

-Continued-

```

*AND CALCULATE THE VARIANCE OF THE REPORT PERIOD PROPORTION (COCHRAN 1977);
data varprop; set varprop (drop = _type_ _freq_);
  phatoth=phatrp1+phatrp4+phatrp6+phatrp8+phatrp10+phatrp9;
  format phatrp1-phatrp10 phatoth stdprp1-stdprp10 3.2;
  format adjcatch 4.0 date date7.;
  label phatrp1='CHINOOK' phatrp2='CHUM' phatrp3='CHARR' phatrp4='PIKE'
    phatrp5='PINK' phatrp6='SHEEFISH' phatrp7='WHITE' phatrp8='FLOUNDER'
    phatrp9='OTHER' phatrp10='CISCO' phatoth='OTHER';
  label stdprp2='CHUM S.E.' stdprp3='CHARR S.E.' stdprp5='PINK S.E.'
    stdprp7='WHITE S.E.';
  array varprp{10} varprp1-varprp10;
  array smsqdv{10} smsqdv1-smsqdv10;
  array stdprp{10} stdprp1-stdprp10;
  array cvprop{10} cvprop1-cvprop10;
  array phatrp{10} phatrp1-phatrp10;
  do i = 1 to 10;
    varprp{i}=smsqdv{i}/(n*(n-1));
    stdprp{i}=sqrt(varprp{i});
    if phatrp{i} gt 0 then cvprop{i}=stdprp{i}/phatrp{i};
    else cvprop{i}=0;
  end;
run;

title2 'ESTIMATED RIGHT BANK SPECIES PROPORTIONS AND STANDARD ERRORS';
title3 'BY REPORT PERIOD';
title4 'major species only';
proc print label data=varprop noobs;
  var reportno date adjcatch phatrp2 phatrp3 phatrp5 phatrp7 phatoth
    stdprp2 stdprp3 stdprp5 stdprp7;
run;

*
*
*NOW MERGE DATA SET CONTAINING COUNTS WITH DATA SET CONTAINING PROPORTIONS,
AND CALCULATE SPECIES PASSAGE ESTIMATES AND THEIR ESTIMATED VARIANCE;
*
*;

data reptstat;
  merge varprop reptpasg;
  by reportno;
  array phatrp{10} phatrp1-phatrp10;
  array varpsg{10} varpsg1-varpsg10;
  array varprp{10} varprp1-varprp10;

```

-Continued-

```

array psg{10} psg1-psg10;
do i=1 to 10;
  psg{i}=phatrp{i}*passage;
  varpsg{i}=(passage**2)*varprp{i};
end;
format passage psg1-psg10 8. varprp1-varprp10
      varpsg1-varpsg10 e9. phatrp1-phatrp10 5.3;
run;

*OPTIONAL PRINTOUT FOLLOWS;
/*
title2 'Dataset reptstat';
proc print data=reptstat label;
  var reportno date passage phatrp1-phatrp10
      varprp1-varprp10 psg1-psg10 varpsg1-varpsg10;
run;
*/

data reptstat; set reptstat (drop = _type_ _freq_);
* file 'nlrepsht.dat';                                *PATH;
  label reportno='REPORTING PERIOD' date='ENDING ON';
  label psg1='CHINOOK' psg2='CHUM' psg3='CHARR' psg4='PIKE' psg5='PINK'
      psg6='SHEEFISH' psg7='WHITE' psg8='FLOUNDER' psg9='OTHER' psg10='CISCO';
  format psg1-psg10 7. varpsg1-varpsg10 e9.;
* put reportno date psg1-psg10 / varpsg1-varpsg10;
run;

title2 'ESTIMATED RIGHT BANK FISH SPECIES PASSAGE BY REPORTING PERIOD';
proc print label noobs data=reptstat;
  var reportno date;
  sum psg2 psg3 psg5 psg7 psg1 psg4 psg6 psg8 psg10 psg9;
run;

proc summary data=reptstat;
  var psg1-psg10 varpsg1-varpsg10 date;
  output out=cumstat sum(psg1-psg10)=cumpsg1-cumpsg10
      sum(varpsg1-varpsg10)=varcpl1-varcpl10
      max(date)=enddate;
run;

data cumstat; set cumstat (drop=_type_);
  rename _freq_=nreports;
run;

```

-Continued-

```
proc transpose data=cumstat out=cs1;
  by nreports;
  var cumpsg1-cumpsg10; run;
data cs1; set cs1;
  label coll='PASSAGE TO DATE';
  rename coll=cumulpsg;
  length species $ 11;
  if _name_ = 'CUMPSG1' then species = ' 9 CHINOOK ';
  if _name_ = 'CUMPSG2' then species = ' 1 CHUM';
  if _name_ = 'CUMPSG3' then species = ' 2 CHARR';
  if _name_ = 'CUMPSG4' then species = ' 8 PIKE';
  if _name_ = 'CUMPSG5' then species = ' 3 PINK';
  if _name_ = 'CUMPSG6' then species = ' 6 SHEEFISH';
  if _name_ = 'CUMPSG7' then species = ' 4 WHITE';
  if _name_ = 'CUMPSG8' then species = ' 7 FLOUNDER';
  if _name_ = 'CUMPSG9' then species = '10 OTHER';
  if _name_ = 'CUMPSG10' then species = ' 5 CISCO';
  drop _name_;
run;

proc transpose data=cumstat out=cs2;
  var varcpl-varcpl10; run;
data cs2; set cs2;
  rename coll=variance;
run;

data cumstat2; merge cs1 cs2;
  stderr=sqrt(variance);
  cv=stderr/cumulpsg;
  format cumulpsg 8. variance e10. stderr 7. cv 4.3;
  label nreports='REPORTS TO DATE'
        stderr='ESTIMATED STANDARD ERROR' cv='COEFFICIENT OF VARIATION';
run;

proc sort data=cumstat2; by species; run;
title2 'CUMULATIVE RIGHT BANK STATISTICS BY SPECIES';
proc print noobs label;
  var nreports species cumulpsg stderr cv;
run;
```

Appendix D. Summary of drift gillnet results on the right bank of the Noatak River, 22 July through 9 September, 1994.

DATE	TFPERIOD ^a	STARTOUT	METH	MESH ^b	MINUTES DEPLOYED	CHUM	CHAR	PINK	WF ^c
22JUL94	1	11:09	D	2.75	12.0250	.	.	.	8
22JUL94	2	16:05	D	2.75	11.3250	.	.	.	.
22JUL94	1	10:37	D	4.00	10.9417	.	.	1	.
22JUL94	2	16:36	D	4.00	11.0417	.	.	.	.
22JUL94	1	10:04	D	6.00	10.9750	.	.	.	.
22JUL94	2	17:04	D	6.00	11.0500	1	.	.	.
23JUL94	1	11:19	D	2.75	11.1000	.	.	.	1
23JUL94	2	16:05	D	2.75	11.0917	.	.	.	1
23JUL94	1	10:48	D	4.00	10.9917	.	.	.	2
23JUL94	2	16:35	D	4.00	11.0750	1	.	.	1
23JUL94	1	10:14	D	6.00	11.2333	3	.	.	.
23JUL94	2	17:04	D	6.00	11.0083	9	.	.	.
24JUL94	1	10:52	D	2.75	6.4833	.	.	.	.
24JUL94	2	16:10	D	2.75	6.3750	.	.	.	1
24JUL94	1	10:33	D	4.00	4.9750	.	.	.	.
24JUL94	2	16:40	D	4.00	6.0000	.	.	.	.
24JUL94	1	10:02	D	6.00	6.9000	7	.	.	.
24JUL94	2	17:02	D	6.00	6.1750	1	.	.	.
25JUL94	1	11:25	D	2.75	11.2417	.	.	.	8
25JUL94	1	11:58	D	2.75	6.3583	.	.	.	.
25JUL94	2	16:10	D	2.75	11.3500	.	.	.	.
25JUL94	2	16:39	D	2.75	6.2917	.	.	.	.
25JUL94	1	10:42	D	4.00	10.9833	.	.	1	1
25JUL94	1	11:12	D	4.00	6.0917	.	.	.	.
25JUL94	2	16:53	D	4.00	10.9750	.	.	1	.
25JUL94	2	17:23	D	4.00	5.9250	.	.	.	.
25JUL94	1	9:59	D	6.00	11.1667	1	.	.	.
25JUL94	1	10:29	D	6.00	6.2000	.	.	.	.
25JUL94	2	17:38	D	6.00	10.9417	.	.	.	.
25JUL94	2	18:03	D	6.00	6.1000	1	.	.	.
26JUL94	1	11:26	D	2.75	11.2833	.	1	.	3
26JUL94	1	11:59	D	2.75	6.5250	.	.	.	.
26JUL94	2	15:58	D	2.75	11.4583	.	1	.	2
26JUL94	2	16:30	D	2.75	6.2583	.	.	.	.
26JUL94	1	10:47	D	4.00	11.0250	.	.	.	.
26JUL94	1	11:11	D	4.00	6.0417	.	.	.	.
26JUL94	2	16:44	D	4.00	11.5583	.	.	.	4
26JUL94	2	17:15	D	4.00	6.0583	.	.	.	.
26JUL94	1	10:01	D	6.00	11.1083	4	.	.	.
26JUL94	1	10:34	D	6.00	6.0417	1	.	.	.

-Continued-

Appendix D. (page 2 of 12).

DATE	TFPERIOD	STARTOUT	METH	MESH	MINUTES DEPLOYED	CHUM	CHAR	PINK	WF
26JUL94	2	17:31	D	6.00	11.2667	1	.	.	.
26JUL94	2	17:57	D	6.00	6.0500	.	.	.	.
27JUL94	1	11:14	D	2.75	11.0833	.	.	.	6
27JUL94	1	11:43	D	2.75	6.0333	.	.	.	.
27JUL94	2	16:03	D	2.75	11.0917	.	.	.	4
27JUL94	2	16:31	D	2.75	6.1167	.	.	.	.
27JUL94	1	10:38	D	4.00	10.9750	.	.	.	1
27JUL94	1	11:03	D	4.00	5.8583	.	.	.	.
27JUL94	2	16:43	D	4.00	11.0083	.	.	1	.
27JUL94	2	17:13	D	4.00	5.9167	.	.	.	.
27JUL94	1	9:57	D	6.00	10.9917	2	.	.	.
27JUL94	1	10:26	D	6.00	5.8083	.	.	.	.
27JUL94	2	17:25	D	6.00	10.8917	1	.	.	.
27JUL94	2	17:50	D	6.00	5.8417	.	.	.	.
28JUL94	1	11:40	D	2.75	11.1417	1	1	.	8
28JUL94	1	12:16	D	2.75	6.2250	.	.	.	.
28JUL94	2	16:00	D	2.75	11.1000	.	.	.	3
28JUL94	2	16:26	D	2.75	6.2250	.	.	.	.
28JUL94	1	11:02	D	4.00	10.9583	.	.	.	2
28JUL94	1	11:28	D	4.00	5.9750	.	.	.	.
28JUL94	2	16:38	D	4.00	10.9083	.	.	.	2
28JUL94	2	17:05	D	4.00	5.8750	.	.	.	.
28JUL94	1	10:00	D	6.00	11.0000	20	.	.	.
28JUL94	1	10:48	D	6.00	5.9667	2	.	.	.
28JUL94	2	17:16	D	6.00	10.9167	5	.	.	.
28JUL94	2	17:53	D	6.00	6.0750	1	.	.	.
29JUL94	1	12:28	D	2.75	11.3667	.	.	.	8
29JUL94	1	13:03	D	2.75	6.0833	.	.	.	.
29JUL94	2	16:08	D	2.75	11.4000	.	.	.	1
29JUL94	2	16:39	D	2.75	6.1750	.	.	.	.
29JUL94	1	11:45	D	4.00	11.3250	1	1	.	.
29JUL94	1	12:13	D	4.00	6.6250	1	.	.	.
29JUL94	2	16:52	D	4.00	11.1333	3	.	.	2
29JUL94	2	17:22	D	4.00	5.8250	1	.	.	.
29JUL94	1	10:03	D	6.00	6.8333	37	.	.	.
29JUL94	1	11:23	D	6.00	6.0417	7	.	.	.
29JUL94	2	17:37	D	6.00	5.9833	7	.	.	.
29JUL94	2	18:07	D	6.00	6.0333	4	.	.	.
30JUL94	1	11:44	D	2.75	11.2000	.	.	.	2
30JUL94	1	12:09	D	2.75	6.2583	.	.	.	.
30JUL94	2	16:06	D	2.75	11.4833	.	1	.	2

-Continued-

Appendix D. (page 3 of 12).

DATE	TFPERIOD	STARTOUT	METH	MESH	MINUTES DEPLOYED	CHUM	CHAR	PINK	WF
30JUL94	2	16:31	D	2.75	6.0417	.	.	.	.
30JUL94	1	11:03	D	4.00	10.8417	1	1	1	.
30JUL94	1	11:30	D	4.00	5.9083	2	.	.	.
30JUL94	2	16:43	D	4.00	10.9583	.	.	.	1
30JUL94	2	17:07	D	4.00	5.7417	.	.	.	.
30JUL94	1	10:04	D	6.00	11.1417	4	.	.	.
30JUL94	1	10:43	D	6.00	6.0000	7	.	.	.
30JUL94	2	17:18	D	6.00	11.0000	5	.	.	.
31JUL94	1	11:23	D	2.75	4.3833	.	.	.	1
31JUL94	1	11:39	D	2.75	4.2250	.	.	.	.
31JUL94	2	16:08	D	2.75	7.3000	.	.	.	2
31JUL94	2	16:38	D	2.75	6.1167	.	.	.	2
31JUL94	1	10:47	D	4.00	4.2250	2	.	1	.
31JUL94	1	11:11	D	4.00	4.0833	3	.	.	.
31JUL94	2	16:52	D	4.00	6.1500	1	.	.	.
31JUL94	2	17:19	D	4.00	5.9000	.	.	.	.
31JUL94	1	10:00	D	6.00	4.3583	9	.	.	.
31JUL94	1	10:33	D	6.00	4.1583	4	.	.	.
31JUL94	2	17:30	D	6.00	6.1167	8	.	.	.
31JUL94	2	18:11	D	6.00	3.4083	3	.	.	.
01AUG94	1	11:25	D	2.75	3.3000	.	.	.	.
01AUG94	1	11:39	D	2.75	3.0500	.	.	.	.
01AUG94	2	16:03	D	2.75	11.2167	1	.	.	1
01AUG94	2	16:31	D	2.75	3.6417	.	.	.	.
01AUG94	1	10:59	D	4.00	3.2500	1	.	.	.
01AUG94	1	11:16	D	4.00	2.9250	.	.	.	.
01AUG94	2	16:46	D	4.00	10.7583	1	.	.	.
01AUG94	2	17:15	D	4.00	6.0333	.	.	.	1
01AUG94	1	10:00	D	6.00	3.2583	25	.	.	.
01AUG94	2	17:27	D	6.00	7.3667	3	.	.	.
01AUG94	2	18:02	D	6.00	5.9333	1	.	.	.
02AUG94	1	11:27	D	2.75	9.6417	.	.	.	8
02AUG94	1	11:56	D	2.75	5.9917	.	.	.	.
02AUG94	2	15:59	D	2.75	11.2500	.	.	.	6
02AUG94	2	16:32	D	2.75	5.6000	.	.	.	.
02AUG94	1	10:53	D	4.00	8.8917	1	.	.	.
02AUG94	1	11:16	D	4.00	5.9333	.	.	.	.
02AUG94	2	16:44	D	4.00	11.6417	.	.	.	.
02AUG94	2	17:09	D	4.00	5.9583
02AUG94	1	10:01	D	6.00	9.5083	8	.	.	.
02AUG94	1	10:38	D	6.00	6.0083	3	.	.	.

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Appendix D. (page 4 of 12).

DATE	TFPERIOD	STARTOUT	METH	MESH	MINUTES DEPLOYED	CHUM	CHAR	PINK	WF
02AUG94	2	17:21	D	6.00	6.1833	4	.	.	.
02AUG94	2	17:56	D	6.00	6.0167	3	.	.	.
03AUG94	1	11:14	D	2.75	11.0417	.	.	.	2
03AUG94	1	11:38	D	2.75	5.9917	.	.	.	.
03AUG94	2	16:02	D	2.75	11.0000	.	.	.	2
03AUG94	2	16:27	D	2.75	6.0667	.	.	.	.
03AUG94	1	10:35	D	4.00	10.8333	.	.	.	.
03AUG94	1	11:02	D	4.00	5.8417	.	.	.	.
03AUG94	2	16:39	D	4.00	10.8417	1	.	.	.
03AUG94	2	17:04	D	4.00	5.8500	.	.	.	.
03AUG94	1	9:59	D	6.00	6.9667	2	.	.	.
03AUG94	1	10:21	D	6.00	5.8833	1	.	.	.
03AUG94	2	17:15	D	6.00	3.8667	8	.	.	.
03AUG94	2	17:41	D	6.00	3.8667	1	.	.	.
04AUG94	1	11:27	D	2.75	11.2417	.	.	.	7
04AUG94	2	16:01	D	2.75	11.1750	.	.	.	1
04AUG94	2	16:39	D	4.00	10.9833	.	.	.	.
04AUG94	1	10:43	D	5.00	9.0667	2	.	.	.
04AUG94	1	9:58	D	6.00	3.5333	4	.	.	.
04AUG94	2	17:14	D	6.00	11.0083	3	.	.	.
05AUG94	1	11:15	D	2.75	6.0083	.	.	.	2
05AUG94	1	11:40	D	2.75	5.7917	.	.	.	.
05AUG94	2	16:00	D	2.75	9.5750	.	.	.	2
05AUG94	2	16:25	D	2.75	6.0333	.	.	.	.
05AUG94	1	10:42	D	4.00	7.8250	.	.	.	1
05AUG94	1	11:03	D	4.00	5.7833	.	.	.	.
05AUG94	2	16:38	D	5.00	5.0083	7	.	2	.
05AUG94	2	17:11	D	5.00	6.1167	7	.	.	.
05AUG94	1	9:58	D	6.00	2.5583	12	.	.	.
05AUG94	1	10:27	D	6.00	3.8917	7	.	.	.
05AUG94	2	17:31	D	6.00	2.1750	6	.	.	.
05AUG94	2	17:55	D	6.00	5.9833	3	.	.	.
06AUG94	1	11:43	D	2.75	11.1167	.	.	.	1
06AUG94	2	16:03	D	2.75	11.1083	.	.	.	1
06AUG94	2	16:48	D	4.00	6.0500	1	.	.	.
06AUG94	1	10:50	D	5.00	8.8833	6	.	.	.
06AUG94	1	10:00	D	6.00	1.8917	5	.	.	.
06AUG94	2	17:25	D	6.00	2.9500	9	.	.	.
07AUG94	1	11:28	D	2.75	11.2417	.	.	.	4
07AUG94	1	11:54	D	2.75	6.1083
07AUG94	2	15:58	D	2.75	11.6167	.	.	.	1

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DATE	TFPERIOD	STARTOUT	METH	MESH	MINUTES DEPLOYED	CHUM	CHAR	PINK	WF
07AUG94	2	16:28	D	2.75	5.9833
07AUG94	1	10:47	D	4.00	7.9750	3	.	.	2
07AUG94	1	11:15	D	4.00	5.9500	1	.	.	.
07AUG94	2	16:40	D	5.00	3.5667	11	.	.	.
07AUG94	2	17:18	D	5.00	2.8417	1	.	.	.
07AUG94	1	9:54	D	6.00	3.6667	7	.	.	.
07AUG94	1	10:31	D	6.00	3.9167	8	.	.	.
07AUG94	2	17:27	D	6.00	3.5333	4	.	.	.
07AUG94	2	17:55	D	6.00	3.6083	2	.	.	.
08AUG94	1	11:35	D	2.75	11.5417	.	.	.	7
08AUG94	1	12:08	D	2.75	6.2250	2	.	.	1
08AUG94	2	15:55	D	2.75	11.7333	2	.	.	4
08AUG94	2	16:24	D	2.75	5.1167	1	.	.	.
08AUG94	1	10:57	D	4.00	5.9583	.	1	.	.
08AUG94	1	11:23	D	4.00	4.0917	3	.	1	.
08AUG94	2	16:39	D	5.00	3.5917	7	1	.	.
08AUG94	1	10:02	D	6.00	2.3833	13	.	.	.
08AUG94	1	10:40	D	6.00	2.5750	9	.	.	.
08AUG94	2	17:12	D	6.00	3.5083	13	.	.	.
09AUG94	1	11:09	D	2.75	11.1500	2	.	.	.
09AUG94	2	16:19	D	2.75	6.1667	.	.	.	.
09AUG94	1	10:29	D	4.00	5.8833	7	.	.	.
09AUG94	2	16:44	D	5.00	3.7417	10	.	.	.
09AUG94	1	9:56	D	6.00	2.2083	13	.	.	.
09AUG94	2	17:22	D	6.00	2.3417	3	.	.	.
10AUG94	1	11:48	D	2.75	9.1000	.	1	.	2
10AUG94	2	16:03	D	2.75	9.1000	.	.	.	.
10AUG94	2	16:38	D	4.00	9.0583	.	.	.	.
10AUG94	1	11:07	D	5.00	9.0167	3	.	.	.
10AUG94	1	10:24	D	6.00	6.9750	4	.	.	.
10AUG94	2	17:11	D	6.00	8.9417	3	.	.	.
11AUG94	1	11:26	D	2.75	4.0667	.	.	.	3
11AUG94	2	16:05	D	2.75	4.1750	.	.	.	.
11AUG94	1	10:54	D	4.00	3.9333	.	.	.	.
11AUG94	2	16:40	D	5.00	3.9750	1	.	.	.
11AUG94	1	10:06	D	6.00	4.1083	3	.	.	.
11AUG94	2	17:11	D	6.00	3.9500	10	.	.	.
12AUG94	1	11:23	D	2.75	4.1333	.	.	.	1
12AUG94	1	11:40	D	2.75	6.0250
12AUG94	2	16:05	D	2.75	4.1667
12AUG94	2	16:21	D	2.75	5.8417	.	1	.	.

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Appendix D. (page 6 of 12).

DATE	TFPERIOD	STARTOUT	METH	MESH	MINUTES DEPLOYED	CHUM	CHAR	PINK	WF
12AUG94	2	16:36	D	4.00	3.8250	.	.	.	.
12AUG94	2	16:51	D	4.00	5.6917	.	.	.	.
12AUG94	1	10:49	D	5.00	4.0667	1	.	.	.
12AUG94	1	11:09	D	5.00	5.9167	.	.	.	.
12AUG94	1	10:04	D	6.00	3.99167	13	.	.	.
12AUG94	2	17:03	D	6.00	3.75000	2	.	.	.
12AUG94	2	17:19	D	6.00	3.80833	.	.	.	.
13AUG94	1	12:19	D	2.75	3.49167	.	.	.	.
13AUG94	1	12:35	D	2.75	4.45833	.	.	.	.
13AUG94	2	16:04	D	2.75	2.80833	1	.	.	.
13AUG94	2	16:20	D	2.75	4.18333	.	.	.	.
13AUG94	1	11:49	D	4.00	3.87500	1	.	.	.
13AUG94	1	12:08	D	4.00	5.16667	.	.	.	.
13AUG94	2	16:32	D	5.00	3.32500	.	.	.	.
13AUG94	2	16:49	D	5.00	3.76667	.	.	.	.
13AUG94	1	11:06	D	6.00	4.20833	13	.	.	.
13AUG94	1	11:37	D	6.00	5.12500	.	.	.	.
13AUG94	2	17:07	D	6.00	3.46667	3	.	.	.
13AUG94	2	17:26	D	6.00	3.43333	.	.	.	.
14AUG94	1	11:27	D	2.75	4.17500	.	.	.	.
14AUG94	1	11:45	D	2.75	4.24167	.	.	.	.
14AUG94	2	15:57	D	2.75	4.45833	.	.	.	.
14AUG94	2	16:17	D	2.75	5.08333	.	.	.	.
14AUG94	2	16:29	D	4.00	4.06667	1	.	.	.
14AUG94	2	16:45	D	4.00	4.55833	.	.	.	.
14AUG94	1	10:54	D	5.00	2.27500	1	.	.	.
14AUG94	1	11:15	D	5.00	4.06667	.	.	.	.
14AUG94	1	9:58	D	6.00	4.20000	20	.	.	.
14AUG94	1	10:43	D	6.00	3.90833	.	.	.	.
14AUG94	2	16:58	D	6.00	3.14167	16	1	.	.
14AUG94	2	17:28	D	6.00	4.94167	.	.	.	.
15AUG94	1	11:30	D	2.75	2.00000	.	.	.	1
15AUG94	2	15:58	D	2.75	2.60833	1	.	.	.
15AUG94	2	16:21	D	4.00	1.57500	1	.	.	2
15AUG94	1	11:00	D	5.00	3.33333	7	.	.	.
15AUG94	1	10:00	D	6.00	3.00833	52	.	.	.
15AUG94	2	16:38	D	6.00	6.16667	5	.	.	.
16AUG94	1	11:10	D	2.75	2.14167	.	.	.	1
16AUG94	2	15:58	D	2.75	2.78333	1	.	.	.
16AUG94	2	16:22	D	4.00	1.95833	2	.	.	.
16AUG94	1	10:45	D	5.00	2.05000	5	.	.	.

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DATE	TFPERIOD	STARTOUT	METH	MESH	MINUTES DEPLOYED	CHUM	CHAR	PINK	WF
16AUG94	1	9:59	D	6.00	1.64167	29	.	.	.
16AUG94	2	16:44	D	6.00	1.71667	16	.	.	.
17AUG94	1	10:38	D	2.75	2.07500	1	.	.	2
17AUG94	2	16:04	D	2.75	1.95000	.	.	.	.
17AUG94	1	10:18	D	4.00	1.87500	2	.	.	.
17AUG94	2	16:21	D	4.00	1.94167	1	.	.	.
17AUG94	1	9:55	D	6.00	1.91667	8	.	.	.
17AUG94	2	16:38	D	6.00	1.16667	11	.	.	.
18AUG94	1	10:57	D	2.75	2.51667	.	.	.	.
18AUG94	2	16:04	D	2.75	2.36667	.	.	.	.
18AUG94	2	16:31	D	4.00	2.17500	.	.	.	.
18AUG94	1	10:37	D	5.00	2.07500	.	.	.	.
18AUG94	1	10:10	D	6.00	2.60833	2	.	.	.
18AUG94	2	16:53	D	6.00	2.00833	12	.	.	.
19AUG94	1	11:14	D	2.75	2.22500	1	.	.	.
19AUG94	2	15:55	D	2.75	2.25000	.	.	.	.
19AUG94	1	10:44	D	4.00	1.84167	.	.	.	.
19AUG94	2	16:22	D	5.00	2.00833	.	.	.	.
19AUG94	1	10:07	D	6.00	1.86667	4	.	.	.
19AUG94	2	16:46	D	6.00	2.41667	3	.	.	.
20AUG94	1	10:58	D	2.75	2.80000	.	.	.	.
20AUG94	2	16:02	D	2.75	2.12500	.	.	.	.
20AUG94	2	16:33	D	4.00	1.77500	.	.	.	.
20AUG94	1	10:30	D	5.00	7.32500	1	.	.	.
20AUG94	1	10:02	D	6.00	1.91667	4	.	.	.
20AUG94	2	16:59	D	6.00	2.68333	9	.	.	.
21AUG94	1	11:02	D	2.75	1.95000	.	.	.	.
21AUG94	2	15:57	D	2.75	2.39167	.	.	.	.
21AUG94	2	16:27	D	4.00	2.04167	.	.	.	.
21AUG94	1	10:33	D	5.00	1.89167	.	.	.	.
21AUG94	1	10:02	D	6.00	1.95000	1	.	.	.
21AUG94	2	16:51	D	6.00	1.99167	2	.	.	.
22AUG94	1	11:00	D	2.75	2.11667	1	.	.	.
22AUG94	2	18:20	D	2.75	2.10833	.	.	.	.
22AUG94	2	18:44	D	4.00	1.15000	1	.	.	.
22AUG94	1	10:29	D	5.00	2.09167	2	1	.	.
22AUG94	1	10:03	D	6.00	1.91667	1	.	.	.
22AUG94	2	19:09	D	6.00	1.98333	5	.	.	.
23AUG94	1	11:37	D	2.75	2.20000	1	.	.	.
23AUG94	2	16:03	D	2.75	2.50000	3	.	.	2
23AUG94	1	10:59	D	4.00	1.95000	1	.	.	.

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DATE	TFPERIOD	STARTOUT	METH	MESH	MINUTES DEPLOYED	CHUM	CHAR	PINK	WF
23AUG94	2	16:33	D	5.00	1.24167	14	.	.	.
23AUG94	1	9:55	D	6.00	1.67500	36	.	.	.
23AUG94	2	17:13	D	6.00	1.92500	47	.	.	.
24AUG94	1	11:27	D	2.75	1.70833	.	.	.	2
24AUG94	1	11:44	D	2.75	1.77500	.	.	.	.
24AUG94	2	16:03	D	2.75	2.16667	2	3	.	.
24AUG94	1	11:01	D	5.00	0.95000	10	1	.	.
24AUG94	1	11:19	D	5.00	1.08333	.	.	.	.
24AUG94	1	10:00	D	6.00	1.23333	20	.	.	.
24AUG94	1	10:52	D	6.00	1.67500	.	.	.	.
25AUG94	1	10:37	D	2.75	2.00833	2	2	.	.
25AUG94	1	10:55	D	2.75	2.63333	.	.	.	.
25AUG94	2	16:00	D	2.75	2.29167	.	3	.	3
25AUG94	2	16:19	D	2.75	2.30000	.	.	.	.
25AUG94	2	16:29	D	4.00	1.39167	.	6	.	.
25AUG94	2	16:42	D	4.00	2.00000	.	.	.	.
25AUG94	1	10:04	D	6.00	1.02500	20	.	.	.
25AUG94	1	10:27	D	6.00	1.76667	.	.	.	.
25AUG94	2	16:53	D	6.00	1.09167	5	.	.	.
25AUG94	2	17:09	D	6.00	1.89167	.	.	.	.
26AUG94	1	11:06	D	2.75	2.40833	.	2	.	5
26AUG94	1	11:21	D	2.75	2.93333	.	.	.	.
26AUG94	2	16:29	D	2.75	3.20833	.	2	.	1
26AUG94	2	16:45	D	2.75	3.55833	.	.	.	.
26AUG94	2	16:55	D	4.00	2.82500	.	1	.	1
26AUG94	2	17:08	D	4.00	3.60000	.	.	.	.
26AUG94	1	10:35	D	5.00	1.65000	4	.	.	.
26AUG94	1	10:55	D	5.00	2.54167	1	.	.	.
26AUG94	1	9:59	D	6.00	1.55833	6	3	.	.
26AUG94	1	10:21	D	6.00	2.58333	.	.	.	.
26AUG94	2	17:19	D	6.00	2.42500	5	.	.	.
26AUG94	2	17:35	D	6.00	2.93333	.	.	.	.
27AUG94	1	11:04	D	2.75	2.40000	.	2	.	6
27AUG94	1	11:21	D	2.75	3.20000	.	.	.	.
27AUG94	2	16:04	D	2.75	3.13333	.	2	.	3
27AUG94	2	16:19	D	2.75	2.95833	.	.	.	.
27AUG94	1	10:39	D	4.00	2.09167	1	1	.	.
27AUG94	1	10:53	D	4.00	3.26667	.	.	.	.
27AUG94	2	16:29	D	5.00	1.96667	1	1	.	.
27AUG94	2	16:43	D	5.00	2.44167
27AUG94	1	10:09	D	6.00	3.67500	7	.	.	.

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DATE	TFPERIOD	STARTOUT	METH	MESH	MINUTES DEPLOYED	CHUM	CHAR	PINK	WF
27AUG94	1	10:29	D	6.00	2.97500
27AUG94	2	16:52	D	6.00	1.84167	4	.	.	.
27AUG94	2	17:06	D	6.00	2.93333	.	.	.	.
28AUG94	1	11:00	D	2.75	2.20833	.	.	.	.
28AUG94	1	11:12	D	2.75	3.10833	.	.	.	.
28AUG94	2	16:05	D	2.75	3.23333	.	.	.	.
28AUG94	2	16:20	D	2.75	2.89167	.	.	.	.
28AUG94	2	16:30	D	4.00	2.91667	.	3	.	.
28AUG94	2	16:46	D	4.00	2.91667	.	.	.	.
28AUG94	1	10:35	D	5.00	2.14167	3	.	.	.
28AUG94	1	10:50	D	5.00	3.01667	.	.	.	.
28AUG94	1	10:04	D	6.00	2.25000	3	1	.	.
28AUG94	1	10:22	D	6.00	3.16667	1	.	.	.
28AUG94	2	16:56	D	6.00	3.11667	2	.	.	.
28AUG94	2	17:14	D	6.00	2.88333	.	.	.	.
29AUG94	1	11:15	D	2.75	3.31667	.	.	.	.
29AUG94	1	11:30	D	2.75	3.08333	.	.	.	.
29AUG94	2	16:16	D	2.75	2.73333	.	1	.	.
29AUG94	2	16:33	D	2.75	3.01667	.	.	.	.
29AUG94	2	16:45	D	4.00	2.67500	.	1	.	.
29AUG94	2	17:00	D	4.00	2.85000	.	.	.	.
29AUG94	1	10:43	D	5.00	3.04167	4	1	.	.
29AUG94	1	11:05	D	5.00	2.96667	.	.	.	.
29AUG94	1	10:09	D	6.00	3.48333	6	.	.	.
29AUG94	1	10:32	D	6.00	3.00000	.	.	.	.
29AUG94	2	17:09	D	6.00	3.00000	4	.	.	.
29AUG94	2	17:28	D	6.00	2.86667	.	.	.	.
30AUG94	1	11:01	D	2.75	2.14167	.	.	.	.
30AUG94	1	11:15	D	2.75	3.27500	.	.	.	.
30AUG94	2	15:56	D	2.75	2.95833	.	2	.	.
30AUG94	2	16:13	D	2.75	2.99167	.	.	.	.
30AUG94	2	16:26	D	4.00	2.27500	.	.	.	.
30AUG94	2	16:39	D	4.00	2.88333	.	.	.	.
30AUG94	1	10:35	D	5.00	2.46667	.	1	.	.
30AUG94	1	10:52	D	5.00	2.89167	.	.	.	.
30AUG94	1	9:59	D	6.00	2.01667	10	.	.	.
30AUG94	1	10:25	D	6.00	3.05833	.	.	.	.
30AUG94	2	16:48	D	6.00	3.05000	1	.	.	.
30AUG94	2	17:05	D	6.00	2.81667	.	.	.	.
31AUG94	1	10:49	D	2.75	3.93333	.	7	.	2
31AUG94	1	11:12	D	2.75	3.99167	.	.	.	.

-Continued-

Appendix D. (page 10 of 12).

DATE	TFPERIOD	STARTOUT	METH	MESH	MINUTES DEPLOYED	CHUM	CHAR	PINK	WF
31AUG94	2	16:03	D	2.75	3.38333	.	6	.	.
31AUG94	2	16:25	D	2.75	4.08333	.	.	.	.
31AUG94	1	10:24	D	4.00	3.36667	.	.	.	1
31AUG94	1	10:39	D	4.00	4.00833	.	.	.	.
31AUG94	2	16:35	D	5.00	3.36667	1	1	.	.
31AUG94	2	16:51	D	5.00	3.78333	.	.	.	.
31AUG94	1	9:57	D	6.00	2.24167	5	.	.	.
31AUG94	1	10:14	D	6.00	3.80833	.	.	.	.
31AUG94	2	17:00	D	6.00	3.92500	2	.	.	.
31AUG94	2	17:17	D	6.00	3.76667	.	.	.	.
01SEP94	1	11:01	D	2.75	4.36667	1	8	.	1
01SEP94	1	11:25	D	2.75	5.08333	.	.	.	.
01SEP94	2	15:57	D	2.75	3.68333	2	4	.	.
01SEP94	2	16:17	D	2.75	4.97500	.	.	.	.
01SEP94	2	16:28	D	4.00	4.25833	.	2	.	1
01SEP94	2	16:45	D	4.00	4.80833	.	.	.	.
01SEP94	1	10:33	D	5.00	3.81667	1	.	.	.
01SEP94	1	10:49	D	5.00	4.82500	.	.	.	.
01SEP94	1	10:00	D	6.00	3.91667	5	.	.	.
01SEP94	1	10:21	D	6.00	4.83333	.	.	.	.
01SEP94	2	16:56	D	6.00	4.50833	10	.	.	.
01SEP94	2	17:19	D	6.00	4.61667	.	1	.	.
02SEP94	1	11:01	D	2.75	3.90833	.	.	.	4
02SEP94	1	11:16	D	2.75	3.91667	.	.	.	.
02SEP94	2	16:01	D	2.75	5.03333	1	3	.	4
02SEP94	2	16:21	D	2.75	3.67500	.	.	.	.
02SEP94	1	10:35	D	4.00	3.81667	1	.	.	1
02SEP94	1	10:51	D	4.00	3.75000	.	.	.	.
02SEP94	2	16:30	D	5.00	3.86667	4	1	.	.
02SEP94	2	16:49	D	5.00	3.71667	.	.	.	.
02SEP94	1	10:06	D	6.00	3.81667	3	.	.	.
02SEP94	1	10:25	D	6.00	3.76667	.	.	.	.
02SEP94	2	16:58	D	6.00	3.79167	1	.	.	.
02SEP94	2	17:12	D	6.00	3.72500	.	.	.	.
03SEP94	1	11:05	D	2.75	3.98333	.	.	.	5
03SEP94	1	11:22	D	2.75	3.90833	.	.	.	.
03SEP94	2	16:03	D	2.75	4.03333	2	3	.	.
03SEP94	2	16:22	D	2.75	3.98333	.	.	.	.
03SEP94	2	16:32	D	4.00	3.80833	.	1	.	.
03SEP94	2	16:46	D	4.00	3.78333	.	.	.	.
03SEP94	1	10:36	D	5.00	3.85000	3	.	.	.

-Continued-

Appendix D. (page 11 of 12).

DATE	TFPERIOD	STARTOUT	METH	MESH	MINUTES DEPLOYED	CHUM	CHAR	PINK	WF
03SEP94	1	10:54	D	5.00	4.10000	1	.	.	.
03SEP94	1	10:01	D	6.00	4.03333	8	.	.	.
03SEP94	1	10:26	D	6.00	3.94167	1	.	.	.
03SEP94	2	16:55	D	6.00	3.85833	.	.	.	.
03SEP94	2	17:11	D	6.00	3.81667	.	.	.	.
04SEP94	1	10:54	D	2.75	4.07500	.	3	.	1
04SEP94	1	11:10	D	2.75	4.10000	.	.	.	.
04SEP94	2	16:01	D	2.75	4.26	.	1	.	2
04SEP94	2	16:22	D	2.75	5.28	.	.	.	.
04SEP94	1	10:30	D	4.00	3.87	.	.	.	.
04SEP94	1	10:44	D	4.00	3.84	.	.	.	.
04SEP94	2	16:33	D	5.00	3.92	4	.	.	.
04SEP94	2	16:51	D	5.00	4.82	.	.	.	.
04SEP94	1	9:57	D	6.00	3.87	5	.	.	.
04SEP94	1	10:20	D	6.00	3.83	.	.	.	.
04SEP94	2	17:02	D	6.00	4.78	5	.	.	.
04SEP94	2	17:25	D	6.00	4.91	1	.	.	.
05SEP94	1	10:10	D	2.75	3.86	.	2	.	9
05SEP94	1	10:28	D	2.75	4.87	.	.	.	.
05SEP94	2	17:36	D	2.75	5.04	1	2	.	1
05SEP94	2	18:00	D	4.00	4.83	1	1	.	.
05SEP94	1	9:34	D	5.00	3.70	4	.	.	.
05SEP94	1	9:57	D	5.00	5.55	.	.	.	.
05SEP94	1	9:01	D	6.00	3.83	3	.	.	.
05SEP94	1	9:22	D	6.00	5.65	.	.	.	.
05SEP94	2	18:21	D	6.00	4.83	2	.	.	.
06SEP94	1	11:16	D	2.75	5.70	.	3	.	8
06SEP94	1	11:42	D	2.75	5.11	.	.	.	.
06SEP94	2	16:04	D	2.75	4.18	.	.	.	1
06SEP94	2	16:20	D	2.75	4.10	.	.	.	.
06SEP94	1	10:46	D	4.00	5.53	.	.	.	.
06SEP94	1	11:03	D	4.00	4.92	.	.	.	.
06SEP94	2	16:32	D	5.00	4.12	2	.	.	.
06SEP94	2	16:49	D	5.00	3.90	1	.	.	.
06SEP94	1	10:09	D	6.00	5.34	2	.	.	.
06SEP94	1	10:31	D	6.00	4.97	.	.	.	.
06SEP94	2	17:00	D	6.00	3.92	1	.	.	.
06SEP94	2	17:15	D	6.00	3.84
07SEP94	1	10:10	D	2.75	4.06	.	.	.	7
07SEP94	1	9:51	D	4.00	3.62	.	1	.	.
07SEP94	1	9:28	D	5.00	4.00	3	.	.	.

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Appendix D. (page 12 of 12).

DATE	TFPERIOD	STARTOUT	METH	MESH	MINUTES DEPLOYED	CHUM	CHAR	PINK	WF
07SEP94	1	9:01	D	6.00	4.20	6	.	.	.
08SEP94	1	9:10	D	2.75	4.22	.	.	.	1
08SEP94	1	9:33	D	4.00	4.17	.	1	.	.
08SEP94	1	9:56	D	5.00	4.14	1	.	.	.
08SEP94	1	10:26	D	6.00	3.68	.	.	.	.
09SEP94	1	10:23	D	2.75	4.33	.	.	.	9
09SEP94	1	10:03	D	4.00	3.72	.	.	.	.
09SEP94	1	9:40	D	5.00	4.05	.	.	.	1
09SEP94	1	9:17	D	6.00	4.17	1	.	.	.
					=====	=====	=====	=====	=====
					2332.02	1036	102	9	227

^a Two fishing periods daily, 1000 - 1200 = 1, 1600 - 1800 = 2.

^b Gillnet stretched mesh (in).

^c Whitefish.

Appendix E. Summary of drift gillnet results on the left bank of the Noatak River, 22 July through 9 September, 1994.

DATE	TFPERIOD ^a	STARTOUT	METH	MESH ^b	MINUTES DEPLOYED	CHUM	CHAR	PINK	WF ^c
22JUL94	1	11:32	D	2.75	6.61667	.	.	.	2
22JUL94	2	16:21	D	2.75	6.38333	.	.	.	.
22JUL94	1	10:54	D	4.00	6.05833	.	.	2	.
22JUL94	2	16:52	D	4.00	5.94167	.	.	.	.
22JUL94	1	10:20	D	6.00	6.14167	.	.	.	.
22JUL94	2	17:21	D	6.00	5.91667	.	.	.	.
23JUL94	1	11:35	D	2.75	6.17500	.	.	.	4
23JUL94	2	16:22	D	2.75	6.08333	.	.	.	.
23JUL94	1	11:05	D	4.00	5.95000	.	.	.	.
23JUL94	2	16:51	D	4.00	5.98333	.	.	.	.
23JUL94	1	10:33	D	6.00	6.01667	4	.	.	.
23JUL94	2	17:25	D	6.00	5.92500	.	.	.	.
24JUL94	1	11:01	D	2.75	6.24167	.	.	.	.
24JUL94	2	16:26	D	2.75	6.32500	.	.	.	.
24JUL94	1	10:40	D	4.00	5.93333	.	.	.	.
24JUL94	2	16:48	D	4.00	6.01667	.	.	.	.
24JUL94	1	10:20	D	6.00	5.97500	.	.	.	.
24JUL94	2	17:13	D	6.00	6.12500	.	.	.	.
25JUL94	1	11:48	D	2.75	6.22500	.	.	.	.
25JUL94	2	16:28	D	2.75	6.25000	.	.	.	.
25JUL94	1	11:00	D	4.00	6.01667	.	.	.	.
25JUL94	2	17:10	D	4.00	5.93333	.	.	.	.
25JUL94	1	10:18	D	6.00	5.97500	.	.	.	.
25JUL94	2	17:53	D	6.00	5.98333	.	.	.	.
26JUL94	1	11:49	D	2.75	6.20000	.	.	.	.
26JUL94	2	16:18	D	2.75	6.62500	.	.	.	1
26JUL94	1	11:02	D	4.00	5.97500	.	.	.	.
26JUL94	2	17:04	D	4.00	6.35000	.	.	.	.
26JUL94	1	10:21	D	6.00	5.97500	1	.	.	.
26JUL94	2	17:46	D	6.00	6.45000	.	.	.	.
27JUL94	1	11:34	D	2.75	6.10000	.	.	.	.
27JUL94	2	16:21	D	2.75	6.15833	.	.	.	.
27JUL94	1	10:54	D	4.00	5.87500	.	.	.	.
27JUL94	2	17:03	D	4.00	5.90833	.	.	.	.
27JUL94	1	10:16	D	6.00	5.86667	.	.	.	.
27JUL94	2	17:41	D	6.00	6.01667	.	.	.	.
28JUL94	1	12:06	D	2.75	6.18333	.	.	.	.
28JUL94	2	16:17	D	2.75	6.12500	.	.	.	.
28JUL94	1	11:19	D	4.00	5.91667	.	.	.	.
28JUL94	2	16:54	D	4.00	5.86667	.	.	.	.

-Continued-

Appendix E. (page 2 of 8).

DATE	TFPERIOD	STARTOUT	METH	MESH	MINUTES DEPLOYED	CHUM	CHAR	PINK	WF
28JUL94	1	10:39	D	6.00	5.90833	.	.	.	.
28JUL94	2	17:39	D	6.00	5.92500	2	.	.	.
29JUL94	1	12:52	D	2.75	6.11667	.	.	.	.
29JUL94	2	16:25	D	2.75	6.40000	.	.	.	4
29JUL94	1	12:03	D	4.00	6.21667	.	.	.	.
29JUL94	2	17:13	D	4.00	6.09167	1	.	.	.
29JUL94	1	10:58	D	6.00	5.81667	9	.	.	.
29JUL94	2	17:58	D	6.00	6.06667	2	.	.	.
30JUL94	1	12:00	D	2.75	6.15833	.	.	.	.
30JUL94	2	16:22	D	2.75	6.12500	.	.	.	.
30JUL94	1	11:21	D	4.00	5.89167	.	.	.	.
30JUL94	2	16:58	D	4.00	5.81667	.	.	.	.
30JUL94	1	10:28	D	6.00	6.36667	7	.	.	.
30JUL94	2	17:40	D	6.00	8.00833	34	.	.	.
31JUL94	1	11:31	D	2.75	4.50000	.	.	.	.
31JUL94	2	16:21	D	2.75	6.31667	2	.	.	.
31JUL94	1	10:58	D	4.00	4.25000	2	.	.	.
31JUL94	2	17:04	D	4.00	6.22500	3	.	.	.
31JUL94	1	10:20	D	6.00	3.45833	4	.	.	.
31JUL94	2	17:51	D	6.00	3.67500	9	.	.	.
01AUG94	1	11:32	D	2.75	3.28333	.	.	.	.
01AUG94	2	16:23	D	2.75	6.12500	.	.	.	.
01AUG94	1	11:10	D	4.00	3.30000	.	.	.	.
01AUG94	2	17:03	D	4.00	6.10000	2	.	.	.
01AUG94	1	10:41	D	6.00	2.29167	8	.	.	.
01AUG94	2	17:47	D	6.00	3.17500	6	.	.	.
02AUG94	1	11:45	D	2.75	6.13333	.	.	.	3
02AUG94	2	16:21	D	2.75	6.38333	.	.	.	.
02AUG94	1	11:08	D	4.00	6.33333	.	.	.	.
02AUG94	2	16:59	D	4.00	6.28333	.	.	.	.
02AUG94	1	10:26	D	6.00	6.02500	1	.	.	.
02AUG94	2	17:37	D	6.00	6.20833	4	.	.	.
03AUG94	1	11:30	D	2.75	6.03333	.	.	.	.
03AUG94	2	16:18	D	2.75	6.05000	.	.	.	.
03AUG94	1	10:51	D	4.00	5.88333	.	.	.	.
03AUG94	2	16:55	D	4.00	5.90833	.	.	.	.
03AUG94	1	10:12	D	6.00	5.89167	.	.	.	.
03AUG94	2	17:32	D	6.00	3.87500	1	.	.	.
04AUG94	1	11:47	D	2.75	6.12500	.	.	.	.
04AUG94	2	16:17	D	2.75	6.19167	.	.	.	.
04AUG94	2	16:53	D	4.00	5.96667	.	.	.	.

-Continued-

Appendix E. (page 3 of 8).

DATE	TFPERIOD	STARTOUT	METH	MESH	MINUTES DEPLOYED	CHUM	CHAR	PINK	WF
04AUG94	1	10:58	D	5.00	6.07500	1	.	.	.
04AUG94	1	10:12	D	6.00	5.97500	5	.	.	.
04AUG94	2	17:32	D	6.00	5.93333	.	.	.	.
05AUG94	1	11:31	D	2.75	6.07500	.	.	.	.
05AUG94	2	16:16	D	2.75	6.10833	.	.	.	.
05AUG94	1	10:54	D	4.00	5.99167	.	.	.	.
05AUG94	2	16:55	D	5.00	6.05833	4	.	.	.
05AUG94	1	10:16	D	6.00	2.01667	5	.	.	.
05AUG94	2	17:42	D	6.00	3.84167	5	.	.	.
06AUG94	1	11:59	D	2.75	6.60000	.	.	.	.
06AUG94	2	16:20	D	2.75	6.07500	3	.	.	.
06AUG94	2	17:01	D	4.00	5.95000	2	.	.	.
06AUG94	1	11:09	D	5.00	5.85000	6	.	.	.
06AUG94	1	10:13	D	6.00	2.62500	4	.	.	.
06AUG94	2	17:41	D	6.00	2.38333	6	.	.	.
07AUG94	1	11:45	D	2.75	6.03333	.	.	.	.
07AUG94	2	16:15	D	2.75	6.35833	2	.	.	.
07AUG94	1	11:06	D	4.00	5.98333	1	.	.	.
07AUG94	2	16:56	D	5.00	3.70000	16	.	1	.
07AUG94	1	10:10	D	6.00	4.73333	9	.	.	.
07AUG94	2	17:41	D	6.00	2.30000	7	.	.	.
08AUG94	1	11:54	D	2.75	6.50000	2	.	.	.
08AUG94	2	16:15	D	2.75	6.30000	.	.	.	.
08AUG94	1	11:08	D	4.00	4.05000	5	1	.	.
08AUG94	2	16:55	D	5.00	2.09167	11	.	.	.
08AUG94	1	10:23	D	6.00	1.47500	9	.	.	.
09AUG94	1	11:27	D	2.75	6.14167	2	.	.	.
09AUG94	2	16:02	D	2.75	6.07500	2	.	.	.
09AUG94	1	10:48	D	4.00	4.96667	9	.	.	.
09AUG94	2	16:32	D	5.00	2.25833	3	.	.	.
09AUG94	1	10:15	D	6.00	2.34167	5	.	.	.
09AUG94	2	17:06	D	6.00	2.21667	5	.	.	.
10AUG94	1	12:05	D	2.75	5.93333	.	.	.	1
10AUG94	2	16:16	D	2.75	6.07500	.	.	.	.
10AUG94	2	16:51	D	4.00	5.87500	.	.	.	.
10AUG94	1	11:25	D	5.00	4.71667	.	.	.	.
10AUG94	1	10:40	D	6.00	5.97500	1	.	.	.
10AUG94	2	17:28	D	6.00	5.90833	1	.	.	.
11AUG94	1	11:35	D	2.75	6.10000
11AUG94	2	16:13	D	2.75	6.05833	.	.	.	1
11AUG94	1	11:02	D	4.00	5.92500	1	.	.	.

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Appendix E. (page 4 of 8).

DATE	TFPERIOD	STARTOUT	METH	MESH	MINUTES DEPLOYED	CHUM	CHAR	PINK	WF
11AUG94	2	16:49	D	5.00	5.02500	2	.	.	.
11AUG94	1	10:19	D	6.00	5.89167	7	.	.	.
11AUG94	2	17:28	D	6.00	3.95833	1	.	.	.
12AUG94	1	11:31	D	2.75	5.40000	.	.	.	.
12AUG94	2	16:13	D	2.75	5.05833	.	.	.	.
12AUG94	2	16:43	D	4.00	4.77500	.	.	.	.
12AUG94	1	11:00	D	5.00	4.95000	.	.	.	.
12AUG94	1	10:27	D	6.00	4.81667	1	.	.	.
12AUG94	2	17:12	D	6.00	4.92500	.	.	.	.
13AUG94	1	12:26	D	2.75	4.95833	.	.	.	.
13AUG94	2	16:13	D	2.75	3.75833	.	.	.	.
13AUG94	1	12:00	D	4.00	4.96667	.	.	.	.
13AUG94	2	16:40	D	5.00	3.91667	1	.	.	.
13AUG94	1	11:28	D	6.00	4.55000	1	.	.	.
13AUG94	2	17:18	D	6.00	4.00000	1	.	.	.
14AUG94	1	11:34	D	2.75	5.35000	1	.	.	.
14AUG94	2	16:06	D	2.75	4.97500	1	.	.	.
14AUG94	2	16:37	D	4.00	3.95000	.	.	.	.
14AUG94	1	11:01	D	5.00	5.06667	4	.	.	.
14AUG94	1	10:23	D	6.00	5.20833	12	.	.	.
14AUG94	2	17:21	D	6.00	3.58333	.	.	.	.
15AUG94	1	11:40	D	2.75	4.25000	.	.	.	.
15AUG94	2	16:07	D	2.75	3.18333	1	.	.	.
15AUG94	2	16:28	D	4.00	2.91667	.	.	.	.
15AUG94	1	11:15	D	5.00	4.25000	1	.	.	.
15AUG94	1	10:48	D	6.00	4.25000	5	.	.	.
15AUG94	2	16:49	D	6.00	2.55000	2	.	.	.
16AUG94	1	11:16	D	2.75	2.14167	.	.	.	.
16AUG94	2	16:06	D	2.75	3.16667	.	.	.	.
16AUG94	2	16:30	D	4.00	1.96667	.	.	.	.
16AUG94	1	10:56	D	5.00	1.91667	1	.	.	.
16AUG94	1	10:33	D	6.00	1.61667	2	.	.	.
16AUG94	2	16:58	D	6.00	1.70833	1	.	.	.
17AUG94	1	10:45	D	2.75	2.15000	.	.	.	.
17AUG94	2	16:09	D	2.75	2.3500	.	.	.	.
17AUG94	1	10:27	D	4.00	2.6000	.	.	.	.
17AUG94	2	16:27	D	4.00	1.9500	.	.	.	.
17AUG94	1	10:07	D	6.00	1.9667	1	.	.	.
17AUG94	2	16:51	D	6.00	1.6667	.	.	.	.
18AUG94	1	10:04	D	2.75	32.3667	.	.	.	.
18AUG94	2	16:10	D	2.75	2.6667	.	.	.	.

-Continued-

Appendix E. (page 5 of 8).

DATE	TFPERIOD	STARTOUT	METH	MESH	MINUTES DEPLOYED	CHUM	CHAR	PINK	WF
18AUG94	2	16:38	D	4.00	1.9833	.	.	.	.
18AUG94	1	10:42	D	5.00	2.1667	.	.	.	.
18AUG94	1	10:21	D	6.00	1.9750	.	.	.	.
18AUG94	2	17:07	D	6.00	1.9167	.	.	.	.
19AUG94	1	11:23	D	2.75	3.0833	.	.	.	.
19AUG94	2	16:02	D	2.75	2.9750	.	.	.	.
19AUG94	1	10:51	D	4.00	3.4333	.	.	.	.
19AUG94	2	16:29	D	5.00	2.8000	.	.	.	.
19AUG94	1	10:21	D	6.00	3.1167	.	.	.	.
19AUG94	2	16:57	D	6.00	2.7333	.	.	.	.
20AUG94	1	11:05	D	2.75	3.3917	.	.	.	.
20AUG94	2	16:08	D	2.75	3.6667	.	.	.	.
20AUG94	2	16:39	D	4.00	2.9500	1	.	.	.
20AUG94	1	10:37	D	5.00	3.1667	1	.	.	.
20AUG94	1	10:12	D	6.00	2.9000	1	.	.	.
20AUG94	2	17:22	D	6.00	2.3333	.	.	.	.
21AUG94	1	11:08	D	2.75	2.4000	.	.	.	.
21AUG94	2	16:05	D	2.75	2.8000	.	.	.	.
21AUG94	2	16:33	D	4.00	2.3500	.	.	.	.
21AUG94	1	10:39	D	5.00	2.2500	1	.	.	.
21AUG94	1	10:11	D	6.00	2.6417	.	.	.	.
21AUG94	2	17:00	D	6.00	3.2333	.	.	.	.
22AUG94	1	11:08	D	2.75	2.7750	.	.	.	.
22AUG94	2	18:27	D	2.75	2.3667	.	.	.	.
22AUG94	2	18:51	D	4.00	2.1333	.	.	.	.
22AUG94	1	10:38	D	5.00	2.8167	1	.	.	.
22AUG94	1	10:12	D	6.00	2.5083	.	.	.	.
22AUG94	2	19:19	D	6.00	5.6083	.	.	.	.
23AUG94	1	11:45	D	2.75	2.3083	1	.	.	.
23AUG94	2	16:15	D	2.75	2.6250	.	.	.	.
23AUG94	1	11:08	D	4.00	2.1750	12	1	.	.
23AUG94	2	16:51	D	5.00	2.2083	10	.	.	.
23AUG94	1	10:28	D	6.00	2.2000	9	.	.	.
23AUG94	2	17:46	D	6.00	3.2417	.	.	.	.
24AUG94	1	11:34	D	2.75	2.0583	1	1	.	.
24AUG94	2	16:16	D	2.75	2.2417	2	.	.	1
24AUG94	1	11:13	D	5.00	1.1167	.	.	.	.
24AUG94	1	10:15	D	6.00	2.6667	44	.	.	.
25AUG94	1	10:49	D	2.75	2.4000	.	1	.	.
25AUG94	2	16:11	D	2.75	2.4167	.	.	.	3
25AUG94	2	16:37	D	4.00	2.0750

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Appendix E. (page 6 of 8).

DATE	TFPERIOD	STARTOUT	METH	MESH	MINUTES DEPLOYED	CHUM	CHAR	PINK	WF
25AUG94	1	10:23	D	6.00	1.1250	.	.	.	.
25AUG94	2	17:04	D	6.00	2.2333	.	.	.	.
26AUG94	1	11:14	D	2.75	3.0167	.	.	.	.
26AUG94	2	16:38	D	2.75	3.2583	.	.	.	.
26AUG94	2	17:02	D	4.00	3.15000	.	1	.	.
26AUG94	1	10:46	D	5.00	2.62500	2	.	.	1
26AUG94	1	10:12	D	6.00	2.48333	1	.	.	.
26AUG94	2	17:29	D	6.00	2.97500	.	.	.	.
27AUG94	1	11:14	D	2.75	2.83333	.	.	.	.
27AUG94	2	16:12	D	2.75	3.35833	.	1	.	.
27AUG94	1	10:47	D	4.00	2.94167	.	.	.	.
27AUG94	2	16:37	D	5.00	2.67500	.	.	.	.
27AUG94	1	10:22	D	6.00	2.52500	1	.	.	.
27AUG94	2	17:00	D	6.00	2.37500	.	.	.	.
28AUG94	1	11:05	D	2.75	3.15000	.	.	.	.
28AUG94	2	16:12	D	2.75	3.35833	.	.	.	.
28AUG94	2	16:38	D	4.00	3.28333	.	1	.	.
28AUG94	1	10:44	D	5.00	2.51667	.	.	.	.
28AUG94	1	10:16	D	6.00	2.52500	.	.	.	.
28AUG94	2	17:06	D	6.00	3.20000	1	.	.	.
29AUG94	1	11:23	D	2.75	3.20833	.	.	.	.
29AUG94	2	16:25	D	2.75	3.00833	.	.	.	.
29AUG94	2	16:52	D	4.00	3.08333	.	.	.	.
29AUG94	1	10:56	D	5.00	3.28333	.	.	.	.
29AUG94	1	10:24	D	6.00	3.25833	.	1	.	.
29AUG94	2	17:22	D	6.00	2.22500	.	.	.	.
30AUG94	1	11:07	D	2.75	2.71667	.	1	.	.
30AUG94	2	16:05	D	2.75	3.29167	.	1	.	.
30AUG94	2	16:32	D	4.00	2.74167	.	.	.	.
30AUG94	1	10:46	D	5.00	2.50833	.	.	.	.
30AUG94	1	10:16	D	6.00	2.45000	1	.	.	.
30AUG94	2	16:57	D	6.00	2.54167	1	1	.	.
31AUG94	1	11:03	D	2.75	4.02500	.	2	.	.
31AUG94	2	16:15	D	2.75	4.06667	.	7	.	.
31AUG94	1	10:31	D	4.00	3.81667	.	2	.	.
31AUG94	2	16:44	D	5.00	3.80000	.	.	.	.
31AUG94	1	10:07	D	6.00	3.70000	.	.	.	.
31AUG94	2	17:09	D	6.00	3.76667	1	.	.	.
01SEP94	1	11:15	D	2.75	4.76667	.	2	.	1
01SEP94	2	16:07	D	2.75	4.79167	.	4	.	1
01SEP94	2	16:37	D	4.00	4.64167	1	.	.	.

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Appendix E. (page 7 of 8).

DATE	TFFPERIOD	STARTOUT	METH	MESH	MINUTES DEPLOYED	CHUM	CHAR	PINK	WF
01SEP94	1	10:40	D	5.00	5.35000	.	.	.	.
01SEP94	1	10:11	D	6.00	4.78333	1	1	.	.
01SEP94	2	17:09	D	6.00	4.80000	3	.	.	.
02SEP94	1	11:09	D	2.75	4.18333	.	.	.	.
02SEP94	2	16:11	D	2.75	4.01667	.	1	.	1
02SEP94	1	10:44	D	4.00	3.90833	.	.	.	.
02SEP94	2	16:41	D	5.00	4.43333	.	.	.	.
02SEP94	1	10:16	D	6.00	3.90833	1	.	.	.
02SEP94	2	17:06	D	6.00	3.71667	.	.	.	.
03SEP94	1	11:14	D	2.75	3.65000	.	1	.	1
03SEP94	2	16:13	D	2.75	3.91667	.	.	.	.
03SEP94	2	16:39	D	4.00	3.84167	.	.	.	.
03SEP94	1	10:46	D	5.00	3.89167	1	1	.	.
03SEP94	1	10:15	D	6.00	4.09167	3	.	.	.
03SEP94	2	17:02	D	6.00	3.75833	2	.	.	.
04SEP94	1	11:03	D	2.75	4.12	.	.	.	.
04SEP94	2	16:10	D	2.75	5.42	1	.	.	3
04SEP94	1	10:37	D	4.00	3.94	.	.	.	.
04SEP94	2	16:43	D	5.00	4.57	.	.	.	.
04SEP94	1	10:13	D	6.00	3.90	.	.	.	.
04SEP94	2	17:14	D	6.00	4.93	1	.	.	.
05SEP94	1	10:20	D	2.75	4.37	.	.	.	.
05SEP94	2	17:48	D	2.75	5.09	.	1	.	.
05SEP94	2	18:09	D	4.00	4.82	.	.	.	.
05SEP94	1	9:46	D	5.00	4.99	1	.	.	.
05SEP94	1	9:12	D	6.00	4.63	-2	.	.	.
05SEP94	2	18:30	D	6.00	4.85	.	.	.	.
06SEP94	1	11:34	D	2.75	5.35	.	.	.	.
06SEP94	2	16:12	D	2.75	4.08	.	2	.	.
06SEP94	1	10:54	D	4.00	5.13	.	1	.	.
06SEP94	2	16:43	D	5.00	3.85	.	.	.	.
06SEP94	1	10:21	D	6.00	4.92	1	.	.	.
06SEP94	2	17:09	D	6.00	3.82	.	.	.	.
07SEP94	1	10:19	D	2.75	4.30	.	2	.	.
07SEP94	1	9:59	D	4.00	3.97	.	.	.	.
07SEP94	1	9:40	D	5.00	3.97	.	.	.	.
07SEP94	1	9:15	D	6.00	4.06	1	.	.	.
08SEP94	1	9:20	D	2.75	4.43	.	.	.	1
08SEP94	1	9:42	D	4.00	4.48
08SEP94	1	10:07	D	5.00	4.03
08SEP94	1	10:34	D	6.00	4.82

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Appendix E. (page 8 of 8).

DATE	TFPERIOD	STARTOUT	METH	MESH	MINUTES DEPLOYED	CHUM	CHAR	PINK	WF
09SEP94	1	10:37	D	2.75	4.18	1	.	.	.
09SEP94	1	10:10	D	4.00	4.07	.	.	.	.
09SEP94	1	9:48	D	5.00	4.66	.	.	.	.
09SEP94	1	9:26	D	6.00	3.87	.	.	.	.
					=====	=====	=====	=====	=====
					1288.45	392	38	3	29

^a Two fishing periods daily, 1000 - 1200 = 1, 1600 - 1800 = 2.

^b Gillnet stretched mesh (in).

^c Whitefish.